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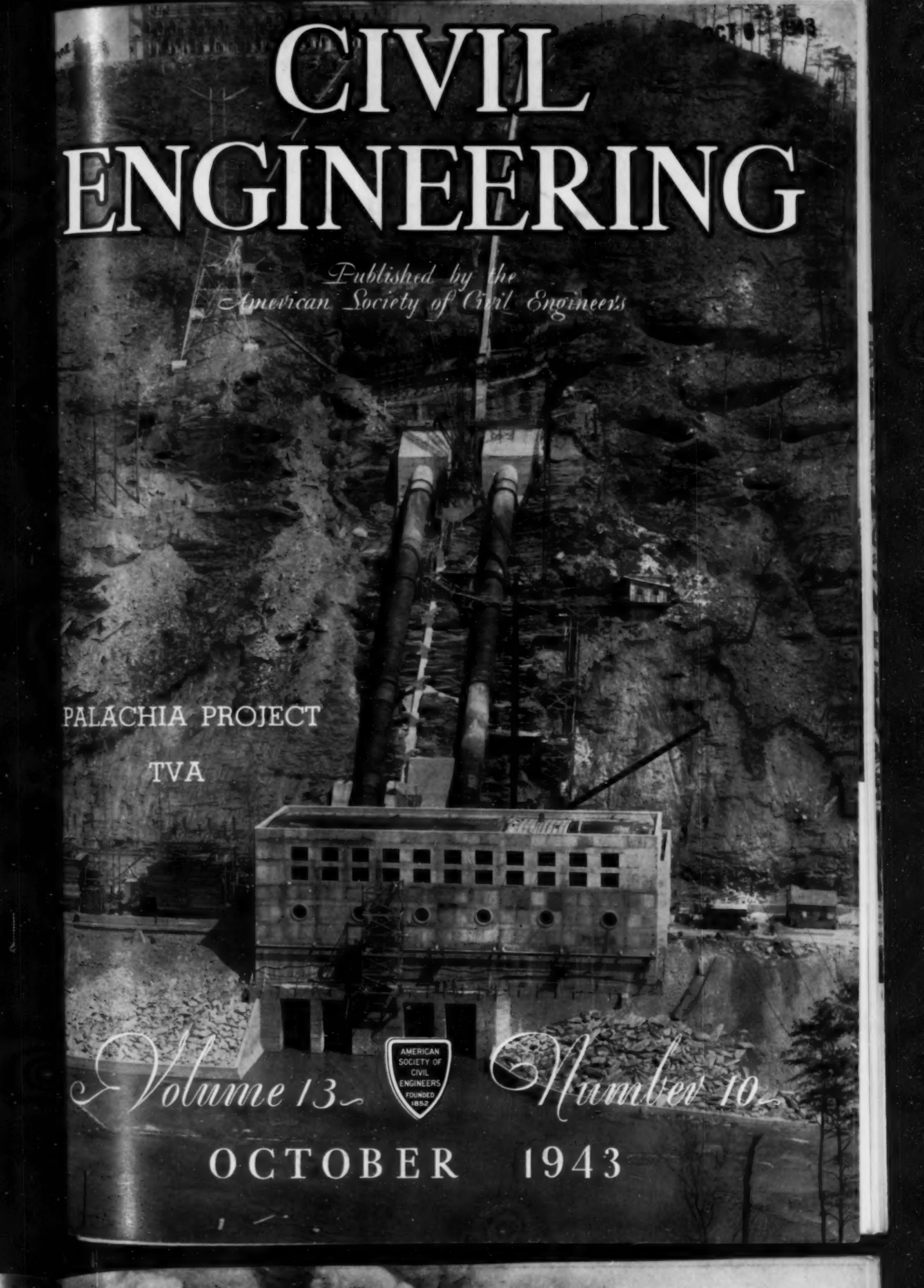

Volume 13 Number 10

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

OCTOBER 1943

can afford to be economical with essential steel

We are lucky that America can, without serious detriment to any phase of the war effort, use steel . . . and produce the steel to use . . . for every indispensable war weapon, material or war production facility that cannot be suitably or safely made of other materials. ● This does not mean that steel is a drug on the market, or that substitutes are not being sought for many purposes, or that these substitutes should not be used when found suitable. ● But it does mean that, when no suitable substitute has been found, America need not attempt to do without steel where steel is necessary. For to do without necessary steel when steel is available, or to use an unsuitable substitute, would be uneconomical and frequently unsafe. In other words, America can afford to be economical with essential steel for essential purposes . . . whether it be for guns and tanks, buildings and their concrete pile supports, or machine tools or bayonets . . . just so long as the requirements are reasonable and the war effort is truly served.

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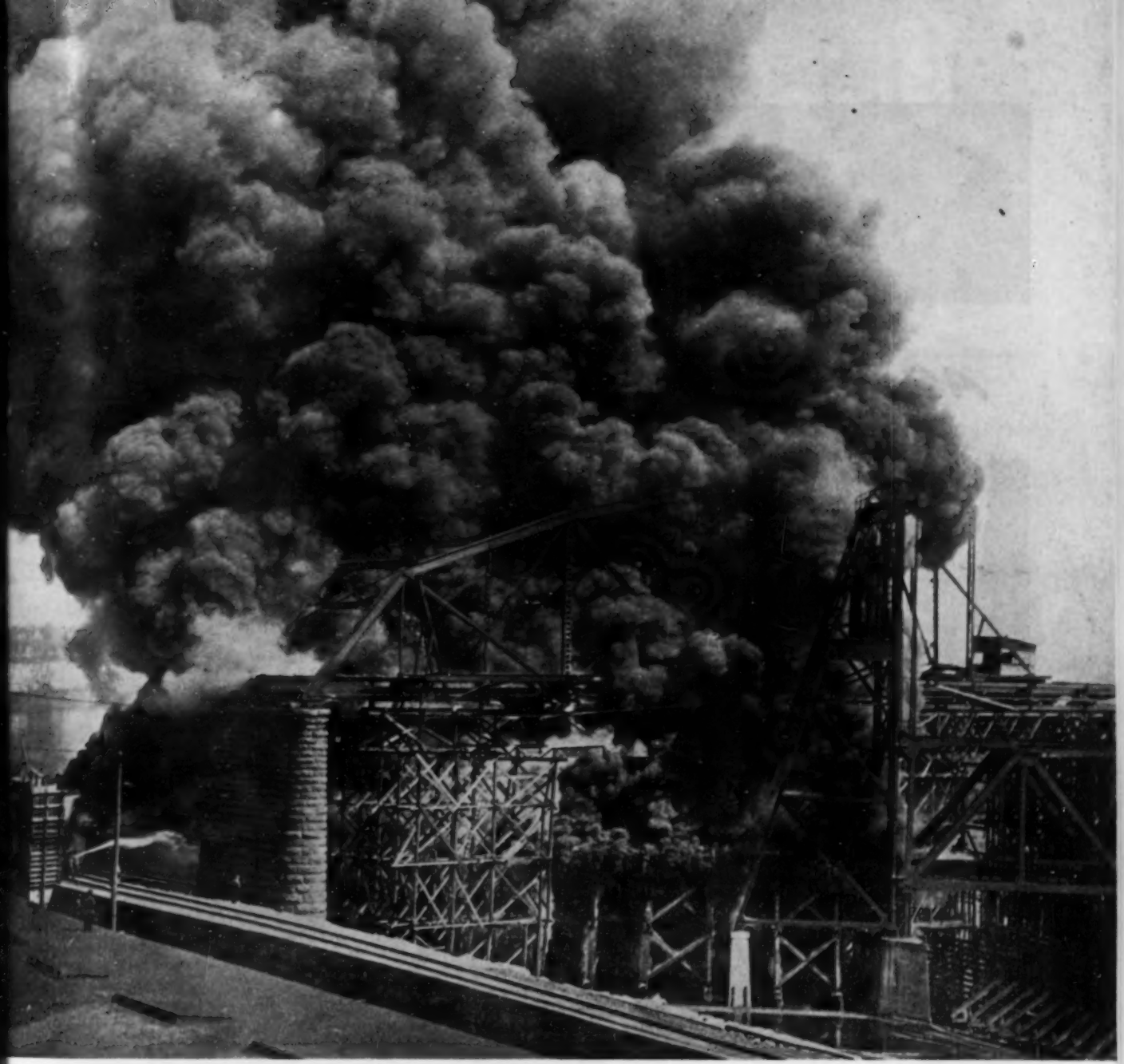

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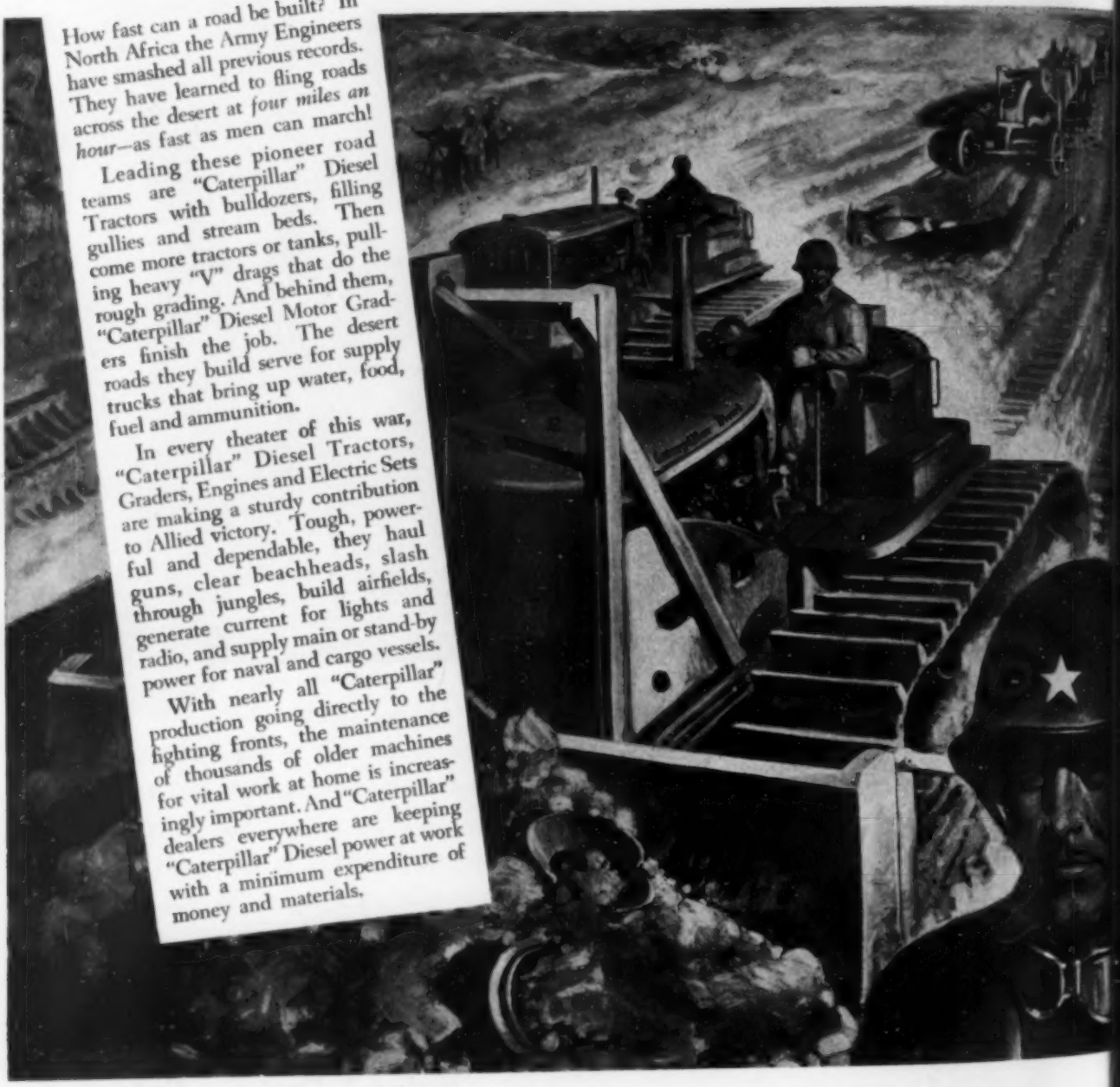

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TO WIN THE WAR: WORK—FIGHT—BUY U. S. WAR BONDS

Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

Why Specifications?

By ROLF T. RETZ, ASSOC. M. AM. SOC. C.E.
CIVIL ENGINEER, U.S. ENGINEERS, WAR DEPARTMENT, JACKSONVILLE, FLA.

THIS question, "Why Specifications?" may seem rather silly. No engineer would ever think of asking "Why drawings?" because every engineer knows that drawings are necessary for the construction of an engineering project. However, not everyone seems to be so sure that specifications are necessary, and this question is often asked in all seriousness. Contractors in particular ask it, and many engineers too.

The general attitude seems to be that construction specifications are unnecessary evils, or merely a bulky set of unimportant papers to which no one pays any attention—except for the purpose of drawing up a contract. In short, specifications are considered as just so much red tape.

Do We Encourage Re Tape?—As engineers, we have a solemn duty to eliminate red tape wherever we find it. This is particularly imperative in wartime, when such inefficiency may prove extremely costly in materials and life. We have therefore a double duty to review our practices in specification writing. We should ask ourselves whether specifications have been handled in a less efficient manner than the rest of our engineering efforts, or whether we have neglected to train our engineering personnel so that it can turn out just as good engineering work in this field as in other fields.

Answering these questions, we find first that the most common criticism against specifications is that they are too long and bulky. This is definitely true. By careful editing, many specifications can be reduced 50 or even 70 per cent in length without losing any of their essentials—the elements needed by a bidder to submit an intelligent bid. An attempt at such simplification has been instituted by a committee working under the auspices of the National Bureau of Standards. In a pamphlet recently published, it is shown how specifications can be cut down in length by using a telegraphic style or a non-sentence structure, which eliminates all excess language and leaves only crisp, technical terms.

A Puzzle for the Bidder.—Next we find that specifications are criticized for being complicated and confusing. There are many of this kind. First come those that are full of cross references from paragraph to paragraph, or exceptions to statements, followed by exceptions to exceptions, in an endless run-around throughout the entire document. This keeps the poor bidder guessing at what is applicable and what is excluded.

Then we have specifications containing references to standard specifications which are unfamiliar or difficult to obtain, or which, when obtained, are found to be superseded one or more times. Furthermore, there are specifications full of bulky extraneous matters, only remotely, if at all, related to the work at hand. All of this forces the bidder to wade through a maze of papers, searching for the kernel of the idea, the thing he "must comply with."

Why Specify Every Screw?—Another kind of specifications equally at fault are the over-fussy ones. These are written by men who think that every little screw, every half pint of paint, every tiny piece of equipment, must be specified. Likewise, they write lengthy and extensive descriptions of materials and manufacturing processes, such as lumber, creosote, steel, or welding specifications, which in many cases are of very old vintage. And we know that specifications do not improve with age.

Such practice is so much more deplorable because it is so easily rectified by reference to applicable national standard specifications. A wonderful tool is at hand in the documents of a number of national organizations, such as the American Society for Testing Materials, the American Standards Association, the American Institute of Steel Construction, and others. Construction specifications should, in general, refer to these standards for materials, manufacturing processes and test methods, and also for the more standardized field processes, such as welding and steel erection.

But other field processes and construction procedures should generally be included in detail, unless result or performance requirements can be specified. The latter is always preferable. Those standard specifications with which the manufacturer is most familiar should be used. Minor items can most readily be covered by a short statement that they "shall be standard commercial grade." Such practices, if adopted generally, would eliminate much of the criticism against over-fussy specifications.

Another Failing, Ambiguity.—Finally, many specifications are full of ambiguities. These are found in care-

lessly worded requirements or in ideas that are not thought through. The most common example of an ambiguous phrase is "as directed by the engineer," a term which does very little except create doubt as to what the engineer will require.

As a consequence of these weaknesses, many small concerns dare not bid on work with this kind of specifications. This is because these bidders do not understand the specifications, and do not have the time or ability to study them. Accordingly, in order to stay out of trouble, they refuse to bid. Thus such specifications, instead of being an assistance in getting bids, are an actual obstacle.

Is it any wonder that contractors and field engineers alike consider specifications unnecessary and superfluous? As a result of this attitude, we find that contractors submit bids without bothering to study the specifications, and in a few known cases, even without having seen them.

A Frank Admission.—The responsibility for this situation rests solely with the engineering profession, and both government and private engineers must take the blame. The situation that has been described is particularly true of government specifications, although in all fairness to the government engineers it should be noted that when a private engineering and architectural firm writes specifications for government work, they are generally no better, and very often worse. It seems that most men who have anything to do with government work invariably feel that it must have a lot of red tape. They do not seem to realize that if there is red tape, the responsibility for it rests primarily with them.

There is absolutely no excuse for tolerating any red tape in engineering specifications. If they are to serve their purpose, they can be and must be simple. This is necessary because specifications do, of course, have a very definite purpose in any construction project. Their basic function is to supplement the drawings. The function of the drawings is to show what the work is, where it is, and how big it is (scope, location, and dimensions). Where the drawings show everything necessary to construct the project, no specifications are necessary. But in most cases the drawings are inadequate to describe all the work to be done. The main points to be covered under the specifications are:

1. Scope of work under contract, that is, work included and work excluded.
2. Performance or result requirements.
3. Materials and equipment requirements.
4. Workmanship and installation requirements.

If an engineering project is to be done in an economical, efficient, and technically good manner, these main points are necessary. Anything else is extraneous. Keeping these main points in mind, it should be a simple job to write a short, clear, understandable specification, free from ambiguities and over-fussy or complicated requirements. It should be simple, but it is very seldom done.

One may wonder why it is not possible to obtain the same degree of excellence in writing specifications as in making drawings. We usually have little difficulty in getting draftsmen and designers who can make drawings that are quite useful for the purpose intended. Of course, these men have had training in the work, a training which involves not only the manual labor but also the more important process of thinking the job through, of analysis and synthesis. But how many draftsmen and designers have had a corresponding training in writing specifications? Very few indeed.

Training to the Rescue.—That may give the answer to the question "Why specifications?" Specifications are for all practical purposes useless unless they are free from the weaknesses and defects that have been outlined. On the other hand, specifications can fulfill their purpose and be of valuable assistance to engineer and contractor alike, if these defects are eliminated. The only way to accomplish this is to provide training for those who do this work, in the same way that draftsmen and designers are trained.

Specifications writing is no drudgery. It may seem very specialized, but actually it touches upon many fields. The specification writer must know English, and how to express himself. He must be familiar with materials, and with manufacturing and construction practices, and must know the various national standardization organizations and their publications. He must likewise be familiar with contract law. And, of course, he must have practical experience coupled with good common sense.

The larger governmental and private organizations should organize their engineering work so that young men will be given adequate training in specification writing. The office should be supplied with a well-equipped library of national standard specifications, and the specification writers should be sent on frequent trips to the construction project. We might then be able to rid ourselves of much bad practice, and obtain specifications that would benefit the consumer, the engineer, the producer, and the contractor alike. This in turn would result in a wider field of bidders, a better understanding and good will between all concerned, and a lower or fairer price.

The Necessary Corollary.—However, the question "Why Specifications?" has not yet been entirely answered because good specifications alone will not guarantee that the owner gets what he wants. A necessary corollary is adequate inspection. It serves very little purpose to have well-written specifications if these are not strictly observed, and this will happen only if there are competent inspectors at places of manufacture and construction.

To compensate for lack of inspection, some engineers require that "The contractor shall guarantee that the materials and work meet the requirements of the specifications." One must be very naïve indeed to believe that such a clause will insure compliance with the specifications. Therefore any engineering organization that neglects to provide for adequate and competent inspection is only fooling itself. Such inspection is just as important as well-prepared design, drawings, and specifications.

Accordingly, besides training its specification writers, a progressive engineering organization will also train inspectors of materials, equipment, and construction. These two fields—specifications and inspection—are complementary. One without the other is like a one-legged man. Together they form the basis for good engineering works.

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VOLUME 13 NUMBER 10

Steel Caissons Support New Orleans Dock

By C. G. Cappel, M. Am. Soc. C.E.
W. Horace Williams Company, New Orleans, La.

DESIGN and construction of a ship repair dock for the Navy in the harbor at New Orleans, La., involved a method without precedent on the lower Mississippi. To carry the loads of a traveling gantry and locomotive crane, a massive, heavily reinforced concrete deck is provided, supported on cylindrical steel caissons. These cylinders range from 4 ft to 4½ ft in diameter and from 77 to 107 ft in length. The shells, ½ in. thick at the top and ⅜ in. thick at the bottom, were filled with concrete. In typical sections the caissons are placed three in a bent, 18 ft 6 in. on centers, the bents being 20 ft on centers. Transitional sections followed the same general principle. Joints for free expansion are provided in the decks at approximately 120-ft intervals. As the critical part of this construction was entirely with out precedent along the lower Mississippi, the contractor was faced with numerous problems. How were caissons of such size to be handled? How were they to be held in place against the effect of the current until they were well seated?

Among the many methods considered for sinking was the time-honored one of weighting the caissons and digging them out. It was estimated that 1,100 lb per sq ft would have to be put on the penetrated surface to move the caisson. Also, considering the very small diameter of the caissons, it seemed questionable whether a bucket could be operated inside them.

It was finally decided that they would be delivered to the site full length. An 80C double-acting hammer and a O-R hammer were used in the driving. The design of the driving hood required a great deal of study. Hoods could not be changed for caissons of different diameters, and the three sizes were so nearly the same that grooves to receive their tops would not have sufficiently strong side walls to withstand the terrific beating they would receive.

The first driving hood designed weighed about 16,000 lb but as no foundry in the South was available to make a casting of this size, the weight was reduced. Grooves in the base of the driving hood were arranged on the principle of internal retention, assuming that the caisson would stand up better under spreading than under squeezing. There was danger that the top of the caisson would roll during driving, so the grooves were made in concentric circles to contact the inner edges of the caissons. A cast-steel thimble filled with ½-in. and 1-in. loose plates was used as a cushion plug. The springiness of the loose plates was depended upon to give sufficient cushion against the punishment on the hammers. Special leads with sufficient spread to take the largest caisson were constructed with a semi circular bolster in front of the hood for spotting the caisson. It was found unnecessary to have a second bolster at the top of the caisson to counteract the pressure of the current, which we had feared would have a tendency to push the caisson out at the top before it was seated on the bottom.

The next problem was to determine whether or not these caissons could be driven without excavating simultaneously. We were all of the opinion that after a certain penetration had been reached, the enclosed earth would form a plug which would cause us to be driving a total stick 4 ft in diameter, which we thought was impossible, or else that we would be driving against frictional resistance both inside and outside of the caisson. To remove the plug of soil inside the caisson during driving, a powerful jet pump was mounted on the driving as-

NEARLY COMPLETED WHARF SECTION SUPPORTED ON STEEL CONCRETE-FILLED CAISSONS

sembly; this pump was capable of developing a pressure up to 1,000 lb per sq in. with comparatively small volume, or up to 1,000 gal per min under a 300-lb pressure. In order that the jetting operation might be carried on simultaneously with the driving, holes were provided in the driving hood.

It was originally intended to use an air agitator, in order to make possible excavation and driving at the same time. However, it was found that the jet pump was powerful enough to keep the earth inside the caisson practically fluid, and that the operation of the air agitator simultaneously with driving and jetting would complicate and slow up the driving. The two operations were therefore done separately. The caissons were thus successfully driven from 40 to 70 ft into the bottom—an average of approximately 60 ft.

SPECIAL DRIVING LEADS PICKING UP A CYLINDER
Steel Caissons Were Delivered and Driven in One Piece

Caissons were delivered in barges to the site, picked up in single pieces, spotted by instruments to the exact driving location, and driven by the hammer until a resistance of some 30 to 40 blows per ft was encountered, at which time the jet was inserted inside the caisson and driving and jetting continued to the required penetration. Driving conditions varied considerably. The least resistance encountered while jetting was 15 blows per foot, and the maximum was about 300.

As originally designed, the caissons had splice plates on the inside at each horizontal joint and a cutting edge composed of one 12-in. wide, $^{3}/_{4}$-in. band around a $^{3}/_{8}$-in. shell. At the request of the contractor, these details were changed to make possible the use of an automatic welding machine. The Jones and Laughlin Steel Corporation, which fabricated the caissons in its New Orleans plant, installed a special machine to make the circumferential welds; in this a very ingenious rack arrangement turned the caisson under the welding machine. All plates were ordered in proper length so that there would be only one vertical or longitudinal seam per plate, and these seams were staggered in the caisson. The cutting edge was reinforced by the addition of a $^{1}/_{2}$ by 24-in. plate. Splice plates were ommitted.

It was definitely determined under field conditions that good welding will withstand any amount of hard driving but that poor welding will not. Some few caissons delivered with hand-made welds failed under driving conditions. Examination clearly showed that the failure was due to poor welding. All this trouble was overcome by machine welding.

The site of the dock has been used for ship repair since the time of Jean LaFitte, so it was expected that all manner of obstructions would be encountered. To remove these as far as possible, the site was cleaned with a clamshell bucket, which eliminated quite a bit of timber and the like. Actually few obstructions were encountered. One or two logs, and what was apparently an old wooden barge, were cut through by heavy driving and the use of the jet. This jet was powerful enough to cut off a wooden pile at practically any depth we could reach by the force of the water only. One caisson cut through some 3 ft of timber in this manner.

The only other major obstruction encountered in the course of the driving was an old steel tank or boiler, the exact nature of which was never determined. We finally excavated around it, found a manhole in it where we could make a line fast, towed it out into deep water, and let it go.

Caissons could not be excavated closer than about 8 ft of the toe without danger of blow-ins. In trying to excavate deeper, we caused one caisson to fall suddenly 4 ft under its own weight from a blow-in. Excavation was very efficient, using a 6-in. pipe with a $1^{1}/_{2}$-in. air connection turning up into the bottom. Air was supplied by a 315-cu ft air compressor; agitation was accomplished by an ordinary jet pump providing about 150-lb pressure and 300 gal per min. Where the soil was sandy, excavation was very rapid, but there it was clayey, it was slow. However, the operation as a whole was very satisfactory. An auxiliary pump kept the water inside the caisson at any desired level.

For placing the concrete in the caisson, to within about 8 ft of the toe, it was planned to use an under-water concrete bucket. This is nothing but a long pipe some 16 to 20 in. in diameter with a closely fitting gate in the bottom. The load line is attached to this gate, thus keeping it tight until the bail line is pulled and the load line let off after the bucket has been seated in the fresh concrete.

SUPPORTS FOR CONCRETE FORMS WERE BRACKETED TO STEEL CAISSONS

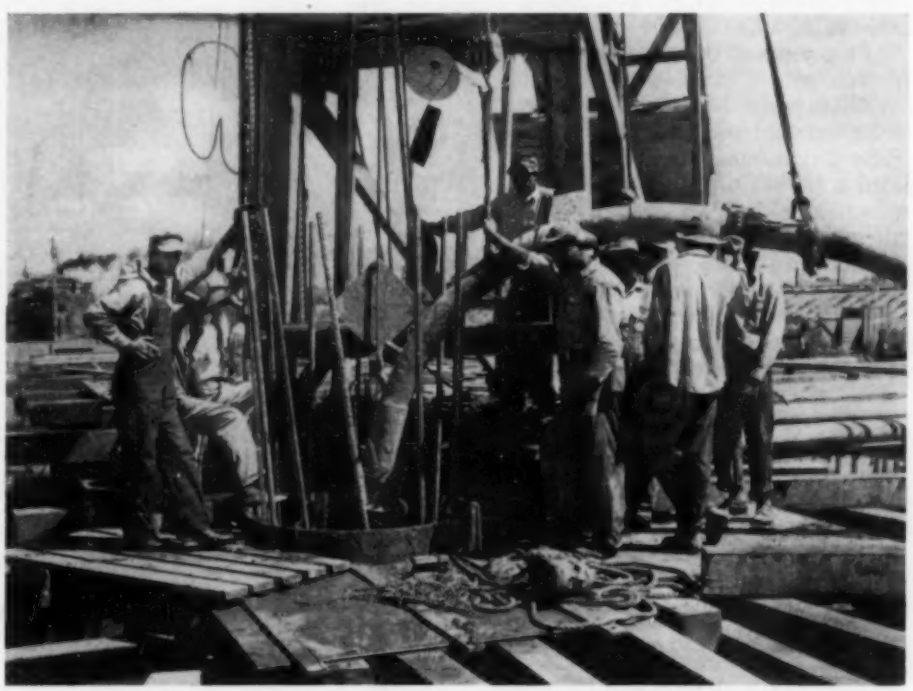
Because of certain objections to this method, it was finally decided to use pumpcrete equipment with a plant set-up on the land side of the levee where there was a rail connection. The pump was set on the river side of the levee, and a paver placed on a platform at a level with the top of the levee. The paver was served by trucks in the ordinary manner.

The delivery pipe was run down inside the caisson to the very bottom, and a plug in the end of the pipe kept out the water until the line was filled with concrete. The concrete pushed the plug out and then filled the caisson, so that it was necessary to disjoint the pipe in 20-ft sections only. Never at any time in the entire operation was the seal lost.

To support the superstructure during concreting presented quite a problem, which however was solved—and successfully—by welding brackets to the caissons. These brackets support the main girders of the superstructure. On these girders were placed steel beams generally 18 by 7-in., 47-lb, H-beams approximately 4 ft 8 in. on centers, on which were placed longitudinally 8 by 8-in. timbers to support the forms. These forms were built before installation, in a yard adjacent to the work. For concreting the deck, the same plant used for the concreting of the caissons was utilized. This equipment was supposed to deliver approximately 40 cu yd per hour under ideal conditions. Initially it was possible to secure a production of some 32 cu yd per hr on the basis of duplex pump operation with single delivery. It was found, however, that when the delivery distance was within 600 ft, two lines discharged 44 cu yd per hr, which was 10% above that expected. As a matter of fact, this unit could receive and place the ultimate output of a 27-E concrete paver.

It is interesting to note here that from the practical viewpoint, the brackets designed for welding to the caissons appeared to be quite light for the loads to be imposed. To eliminate all skepticism, a field test of the brackets was arranged. Two 25-ton hydraulic jacks were placed between two of these brackets, welded over and under on the caissons. When brackets designed to carry some 25 tons were stressed to the ultimate, it was found that they actually supported more than 50 tons without undue fatigue. This test was quite convincing. It should be mentioned that the forming carried a load unprecedented in this section for construction of its kind. One concrete beam carrying the locomotive-crane tracks was 7 ft wide and 5 ft deep, weighing well over 5,000 lb per lin ft.

The structure was designed for the Todd-Johnson Dry Docks, Inc., by Frederic R. Harris, Inc., consulting engineers of New York, N.Y. Construction was accomplished by the W. Horace Williams Company, of New Orleans, under the personal supervision of the writer, a member of the firm. The Navy was represented by Lt. Comdr. H. C. Crandall, Officer-in-Charge of Construction, ably assisted by Lt. C. Spitzfaden, Jr. After construction was completed, Lt. Comdr. Crandall was moved to another assignment and Lt. Comdr. J. G. Gilbert took over and directed completion of the records.



CONCRETE BEING PUMPED INTO A CAISSON—FROM A PLANT LOCATED ON LAND

Needed for the Postwar Period

Public Works to Absorb Excess Employables

By WILLIAM N. CAREY, M. AM. SOC. C.E.

COLONEL, CORPS OF ENGINEERS, U.S. ARMY; CHIEF ENGINEER, FEDERAL WORKS AGENCY, WASHINGTON, D.C.

APPARENTLY everyone has a postwar plan. Members of Congress have evolved 27 or more bills on postwar plans since the first of the year without passing a single general public-works planning bill. Daily hundreds of speakers present their own personal schemes by radio, press, and to the local luncheon club. Yet no agreement upon a workable program has been reached. In this address, which was presented before the Thirtieth Annual Convention of the League of Minnesota Municipalities, Colonel Carey warns that if the staggering costs of improvised projects and direct relief are to be avoided agreement must be reached and plans prepared.

UNEMPLOYMENT and want have always been Siamese-twin ghosts ready to haunt any municipality at the slightest opportunity. We have been well haunted before. Must we face that fear again? Is there real danger of large-scale unemployment lurking just beyond the armistice? With eleven million or more men in the armed services at the end of this war and other millions in specialized war industries, it is any one's guess as to just how many men there will be, able and willing to work, who cannot immediately be absorbed by private industry and agriculture after peace is declared. Experts disagree and use different bases for their figures. While their guesses cannot be really accurate, we cannot escape the assumption that there may be many millions. If plans for employment are not made now, war veterans will be found in the bread lines, in the soup kitchens, among the street corner apple-sellers, and there will be those other thousands forced to exist on a bare subsistence wage made possible by "make-work" projects.

Plans and ideas for our salvation in the postwar period are advanced and discussed daily. Postwar thinking ranges from the one extreme of a 100% federally controlled national economy to the other extreme of complete negation of any planning now by any local, state, or federal unit of government for any postwar activity. It is reasonable to assume that the sound path lies somewhere between these two extremes.

Those wishful-thinking optimists who feel that we shall glide gracefully from our wartime economy into a period of great and lasting prosperity for all, usually base their expectations upon the great reduction in the volume of consumer goods that is occurring during the war. They point to the fact that many consumer wants are now being deferred and that large mass savings in the form of war bonds are accumulating. These savings, they believe, will be spent for consumer goods the day after we turn back to business from celebrating a new armistice day marking our certain victory over the Axis. But we may well wonder what there will be to buy during those first months of our hard-won peace. Stocks of consumer goods, household equipment, and automobiles available to wholesalers, jobbers, and merchants are steadily dwindling, and those stocks cannot be fully replenished until factories now making war goods have reconverted to produce peace goods. This reconverting process takes time, and it does not employ a great deal of labor.

Practically all agree that needed public works must be made ready to absorb as many as possible of the employables who are not taken by industry and agriculture. In a letter dated May 22, 1943, President Roosevelt wrote the Vice-President:

"It has been more than two years since I first called the attention of the Congress to the need for preparing in advance plans for public works and improvement projects to be undertaken in the postwar period. During the war we are deferring the construction of every project not vitally needed for war purposes. By so doing we are storing up a reservoir of work that can be undertaken when the war is over and thus be useful in providing employment opportunities and demands for materials. But if such projects are to be ready for rapid inauguration in the postwar period, the plans and specifications must be prepared during the war. . . .

". . .I believe that a federal grant to support the more general planning activities of these (local) governments along with reimbursable advances to cover the de-

FWA Photo

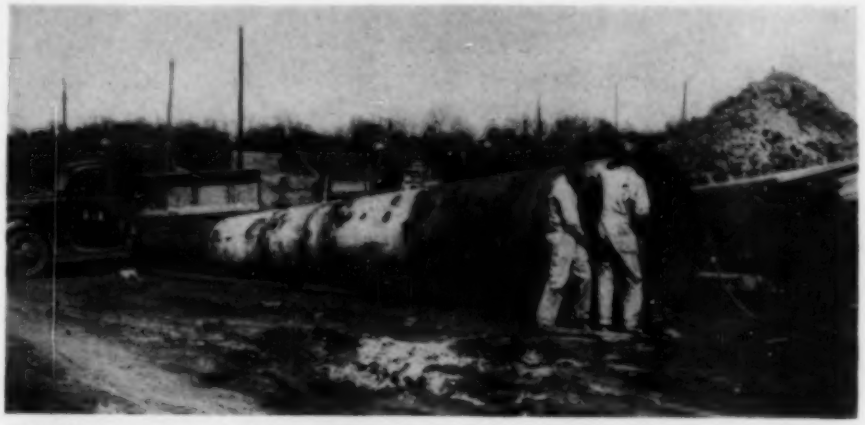
TYPICAL OF PUBLIC WORKS FOR THE POSTWAR ERA IS THE LAKE BURNT MILLS DAM Designed by the Norfolk (Va.) Public Works Department. Concrete Spillway Shown

tailed planning for their individual projects would be an effective means to assure that plans will be ready when they are needed."

With further reference to postwar public works projects, the President, in a memorandum of the same date, to the heads of federal departments and agencies said, in part:

"If, however, such projects are to be ready for a quick start at the time (of need), the plans must be made ready in advance and all the possible preliminary arrangements completed."

It would be easy to assemble a hundred recent quotations in the same vein by prominent citizens, local and national, and of both political parties to show that these leaders are awake to the real need for detailed plans now for postwar work. A large program of public works "ready for a quick start" cannot be developed with a simple turn of the wrist, or even by appropriations of money by Congress, the states, and municipalities. Time—much time—and effort must be expended, in addition to money, before a program can be made ready for operation. We are inclined to forget how much time is necessary even when money to build the needed works is ready and begging for use.



FWA Photo

THIS VENTURI CONE IS PART OF A HOUSTON (TEX.) WATER PROJECT
One of 300 Water Supply Projects Financed by FWA Under the Lanham Act

LEARNING FROM PAST EXPERIENCE

Let us look back for a moment to our experiences during the last severe depression when the Public Works Administration was created by Congress. To PWA was allotted three billion three hundred million dollars to aid, by means of loans and grants, in the construction of needed, sound public works. States, municipalities, and other corporate bodies, which wished to participate in the program, generally had ideas—some of them rather fanciful—but they were all undeveloped. It was necessary to develop the sound ideas into workable, practical undertakings, adequately covered by legislation, financing, and engineering.

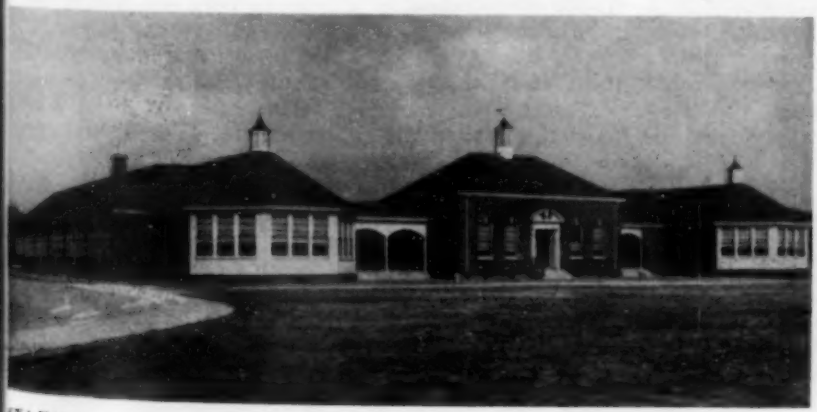
Generally speaking, a large majority of the projects submitted to PWA required state or local legislation to authorize the work and to create a body to construct and operate the project, to authorize bond issues, and for many other purposes, before construction could even be begun. It was necessary to formulate a practical and sound scheme of financing, in some instances to set up trusteeships, to negotiate the sale of securities, and to perform other functions of a financial nature. It was necessary to study the technical features of each contemplated project in detail, to coordinate the proposed work with existing facilities, to prepare working plans and specifications, and to draft other contract documents. It was necessary to attend to, and complete, all these operations, functions, and details before a single man could be put to work on PWA construction. These preliminary, though absolutely vital, steps consumed time, the extent varying with the size, type, and location of the project and with other factors. And the loss of time delayed the fulfilment of the primary purpose of the program, which was to provide jobs quickly. Eighteen months went by before it was possible to put as many as a hundred thousand men to work.

But unemployment and want could not wait for engineers and architects to develop plans and specifications, for the slow processes of law and finance to take their devious courses, and for the working out of the many problems that had been left unsolved before the depression descended upon us. In this dire social emergency, rather than to distribute a dole as such, the President reallocated 400 million dollars of PWA funds to the Civil Works Agency, through which the states improvised projects on which the unemployed could be put to work at once. This was the opening door for the Works Projects Administration and the so-called "security wage." In its earlier years, WPA was also forced to resort to improvised projects of doubtful, if any, permanent value as public works. Sharply divergent views as to proper methods of federal participation in public works for unemployment relief purposes became political issues. It took a second war, with its resultant manpower shortage, to clear the situation to the point where, I believe, nearly all thoughtful citizens will now agree upon the following general principles:

1. That government, both federal and local, has an obligation to help close the gap when private initiative cannot provide all the jobs necessary to maintain full employment.

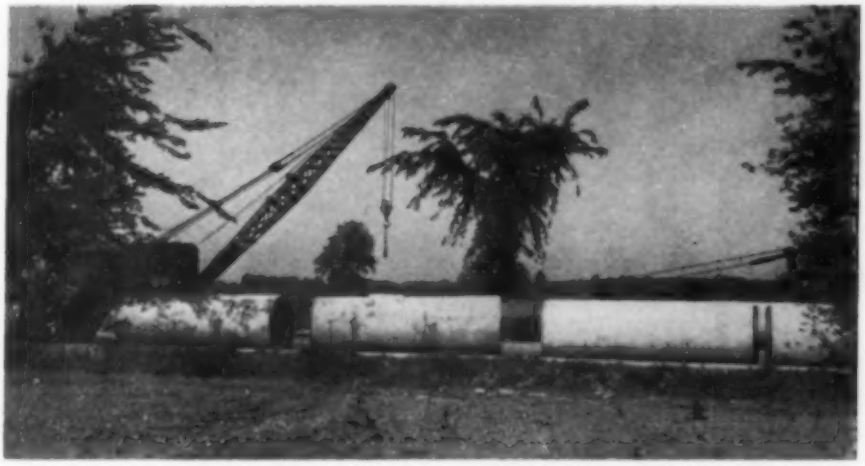
2. That the most useful jobs government can furnish are in the construction of soundly conceived public works which add to the nation's wealth and promote general welfare.

3. That worth-while public works require months of advance planning—



FWA Photo

AN ELEMENTARY SCHOOL AT NEWPORT NEWS (VA.) RECENTLY COMPLETED
Typical of Numerous Buildings to Be Needed at the Close of the War



FWA Photo

CONCRETE PIPE BRINGS WATER TO WAR INDUSTRIES IN THE DETROIT AREA

for engineering surveys, the preparation of plans and specifications, and the acquisition of land. Jobs cannot be called into existence by money alone, or by waving a magic wand.

4. That doles are enervating, and undermine self-confidence, and that no honest man wants a dole as a substitute for a useful job at decent wages.

5. That improvised relief projects are useful in sustaining life, but seldom add much to permanent material wealth.

MUCH DISCUSSION BUT LITTLE ACTION TO DATE

While these principles of a "Declaration of Independence Against Unemployment" are generally conceded, to date little has been accomplished in the way of working them out. Only small and timid beginnings have been made. In December 1941, Congress appropriated ten million dollars to the Public Roads Administration, a unit of the Federal Works Agency, for the purpose of matching the funds of states desiring to make working highway plans and specifications for future highway development. Although this fund has been available for use for the past 17 months, only half of the ten million has been called for to date by the states. New York City is an outstanding example of a municipality that already has allotted substantial funds of its own for the purpose of developing final working plans and specifications for sound and needed public works (See CIVIL ENGINEERING for August, page 353). Some municipalities and states are accumulating reserves in the form of war bonds to finance public works after the war. Taking the country as a whole, however, surprisingly little has been done either nationally or locally toward translating public works ideas into plans and specifications on which bids could be taken. In this sense postwar public-works construction is like Mark Twain's weather. Everybody discusses it, but few are doing anything practical about it.

It should be plainly evident to all that, for maximum success, a postwar public-works program must evolve from the municipalities and the states. Such a program must have its origin in the "grass roots" of the nation. If apathy on the part of local subdivisions of the government finally forces the national government to advance some general emergency made-work program, it is certain to be wasteful of money and non-contributory to permanent prosperity.

Now, while we are still at war and while older engineers and architects are becoming available by the hundreds, we have the best opportunity we are ever likely to have to plan in detail a sound national program of public works. It is reasonable to suppose that we are not going to have a year or two after the war in which to commence to begin to get ready to start these plans. When the boys come home and the millions now working in war industries have been discharged, the need may be immediate. If we have a public works program well prepared in advance, we can provide millions of jobs at once. If we haven't a program prepared—prepared in all its engineering and legal aspects—then we will probably go through the old expensive cycle of CWA and WPA, with hastily improvised projects of little permanent value on which people can be employed at bare subsistence wages. That isn't going to add up to prosperity for anybody. Doubtless private business will eventually provide all the jobs necessary to maintain a general standard of living at a high level. There is no indication, however, that private business, unaided, can handle the colossal job of economic readjustment we must inevitably face in the immediate postwar period.

When we do develop a postwar public works construction program, reason dictates that it should be national in scope and control. It must be national so that it can be integrated into local, regional, and national needs and be capable of management in such a way as to complement the reconstruction efforts of private business. With a controlled national reservoir of worth-while projects, the valve could be turned on in areas where private industry cannot provide all the jobs needed and shut off in areas where private industry alone can absorb the unemployed.

Moreover, without a properly balanced program, we run the risk of seeing public works left to the mercy of various pressure groups. The group that could make the most noise, or exert the greatest political influence, might press its pet projects at the expense of communities in greater need. This could involve enormous waste of public money. For example, magnificant airports might be demanded and built in towns that don't need magnificant airports, superhighways constructed in areas where present roads are adequate, monumental public buildings erected in cities that have a far greater need for adequate water treatment works or sewage disposal facilities, and other works similarly wasteful of public funds constructed.

The question is not, "Can we afford to take such steps as have been here indicated to insure full employment?" but "Can we afford not to take them?" Depressions are exceedingly expensive. The last one is estimated to have cost the nation 200 billion dollars. That sum does not include the staggering cost of relief; it is merely the cost of enforced idleness. It represents the wealth that would have been created if, instead of millions of unemployed, we had had full employment. For considerably less than the war is costing us in this one month of June 1943, we could underwrite full employment for years to come, and assure to ourselves and our children happier, more comfortable, and better living.

If we do not seize the present opportunity to avoid postwar unemployment and to build a better America, it will not be because of any shortage of men, materials, or money, but for some less convincing and less respectable reason.

The Design of Recent TVA Projects

VIII. Apalachia and Ocoee No. 3

By H. W. GOODHUE, ASSOC. M. AM. SOC. C.E., PROJECT ENGINEER, APALACHIA PROJECT
R. L. SMART, PROJECT ENGINEER, OCOEE NO. 3 PROJECT
A. A. MEYER, M. AM. SOC. C.E., HEAD CIVIL DESIGN ENGINEER, TVA

AUTHORIZED in 1941, Apalachia project on the Hiwassee River and Ocoee No. 3 project on the Ocoee River add 102,000 kw to the capacity of the TVA system. Both are designed for power generation only and both utilize a long pressure conduit connecting gravity dam and power house. Their completion marks ten years of outstanding achievement by the TVA since its creation by Congress in 1933. This description of design procedure brings to a close a highly informative series begun by George R. Rich, Chief Design Engineer, TVA, in the March issue.

APALACHIA project on the Hiwassee River and the Ocoee No. 3 project on the Ocoee River are "secondary tributary projects" authorized in July 1941 as part of the "Second Emergency Power Program for National Defense." The two projects have many features in common. Both develop a stretch of river with a steep slope downstream from an existing storage development, and in each case the turbines at the upstream storage development operate on peak loads, their maximum discharge exceeding the capacity of the new plant downstream. The pondage to equalize these peak flows is obtained at both plants by a gravity dam, which acts as a diversion structure at the head of a long water conduit.

These conduits are high-level pressure tunnels, with a short length of steel penstock down the side hill immediately back of the power house. The flow in both conduits is regulated by a differential surge tank. While, as types, the projects are very similar, they vary a great deal in size: Apalachia utilizes a river stretch of 22 miles while Ocoee No. 3 develops a stretch only 11 miles long; the drainage area at the diversion structure at Apalachia is 1,018 sq miles, and at Ocoee No. 3 only 496 sq miles; and the installed capacity at Apalachia is 75,000 kw as compared with 27,000 kw at Ocoee No. 3.

GENERAL LAYOUT OF PROJECTS

Apalachia develops a 22-mile stretch of the Hiwassee River immediately downstream from the Hiwassee project, which is one of the five main tributary storage developments constructed by the Authority. The river follows a relatively narrow valley cut deep into the surrounding mountains. For the first 10 miles it drops only about 11 ft per mile, but for the next 12 miles the slope is steeper, averaging 26 ft per mile. The maximum gross head available is 440 ft.

Located in the area where the change in river grade occurs, the diversion dam is a gravity structure with a maximum height of 150 ft. The reservoir, 10 miles long, provides 37,000 acre-ft of useful storage, ample capacity for equalizing peak operations at Hiwassee. Water is carried from the dam to the power house in a pressure conduit, which is a tunnel for most of its length. In elevation its profile lies just below the minimum pressure gradient; in plan it connects with the power-house site on as straight a line as topography permits. The length of conduit is 8.3 miles, while the river distance between the dam and the power house is 12 miles.

The high-level conduit ends on the face of a steep hillside 220 ft above the river level. Before reaching this face, the tunnel branches into two smaller tunnels, each of which connects to a penstock. A differential surge tank is excavated into the rock immediately back of the tunnel wye. The power house is located at the river's edge at the end of the developed river stretch.

Ocoee No. 3 project develops 11 miles of the Ocoee River to obtain a maximum gross head of 316 ft. It is immediately upstream from the existing Ocoee No. 2 project, which was built in 1912–1913. Some 16 miles upstream of the upper end of the developed stretch is Blue Ridge Dam, which regulates about half the drainage area tributary to Ocoee No. 3 project and provides approximately 183,000 acre-ft of useful storage.

In the lower part of the developed stretch, the river slope is unusually steep, averaging 46 ft per mile, but in the upper half it flattens out considerably. The most economical site for the diversion dam was at the upper end of the steep slope, which in turn allowed the creation of a reservoir above the dam large enough to obtain equalizing storage. The conduit, a high-level pressure tunnel, leaves the reservoir adjacent to the dam and extends 13,000 ft to a portal 180 ft above the river level at the power-house site, at which point a steel-plate differential surge tank is provided. A steel penstock connects to the power house below. Additional head, which is available below the power house, is developed by a tailrace channel excavated within the river bed.

GRAVITY-TYPE DIVERSION DAMS

At Apalachia the dam is a straight gravity structure approximately 1,250 ft long, with a maximum height of 150 ft and a total concrete volume of 220,000 cu yd. The spillway section, 374 ft long, is located in the area of the natural river channel with non-overflow bulkhead sections extending to the abutments at each side. The maximum flood used for the design was estimated at 150,000 cu ft per sec. It is discharged over 10 spillway openings, 32 ft wide, with the masonry crest 25 ft below

APALACHIA DAM ON THE HIWASSEE RIVER—INTAKE PENSTOCK AT RIGHT

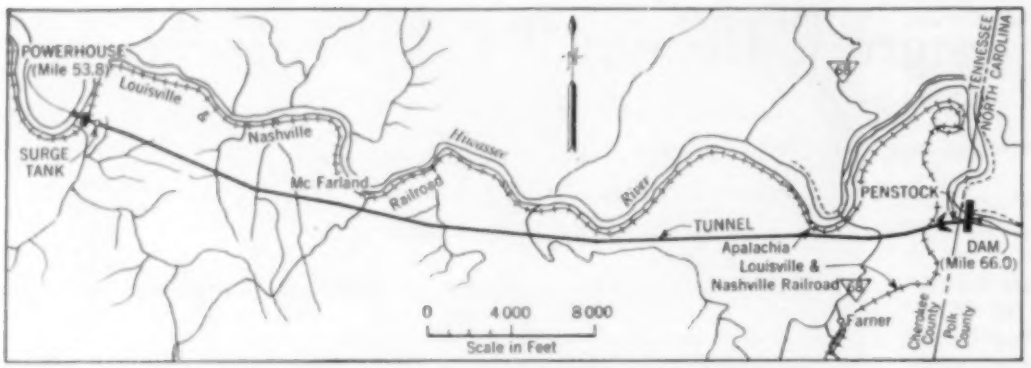


FIG. 1. SITE PLAN FOR APALACHIA PROJECT

the highest assumed pool level. Control of the reservoir is accomplished by means of 10 radial gates, each 23 ft high by 32 ft wide.

While alternate types of dams were carefully investigated, the scarcity of soil adaptable for embankment fill and the unfavorable topographic conditions for a spillway structure apart from the dam made the gravity type the most economical for this site.

The dam is built on formations of micaceous quartzite, hard mica schist, and mica slate, which are somewhat jointed but very tight, and which have ample structural strength for a dam 150 ft high.

The dam is designed in accordance with the basic design assumptions given in the initial article of this series (March and April 1943 issues of CIVIL ENGINEERING). A departure was made from the design of previous TVA spillways in the type of apron used for energy dissipation. The river below the dam being a mountain stream with no structures or improvements along its shores, the natural river bed is used as the zone of energy dissipation. A bucket-type apron lifts the body of discharging water at the downstream end of the structure in order to separate the scouring zone from the foundation of the dam. Hydraulic laboratory tests were carried out to obtain assurance of this undisturbed zone. A 20° bucket angle indicated unusually favorable conditions.

For the radial gates, an available design originally developed for the Hiwassee project was re-used. For their anchorage a heavy steel casing is extended through the pier, and the gate trunnion pin is set and welded into this casing. Reinforcing bars are bent around the casing and extended upstream into the pier to provide a direct and efficient load distribution. The gates are operated by individual hoists. Convenience of operation and the possibility of future remote control from the distant power house determined the choice of this type of operating mechanism, which is slightly more expensive than the traveling hoists used on other TVA dams.

FEATURES DISTINGUISHING OCOEE NO. 3 DAM

At Ocoee No. 3, the dam is 610 ft long, with a maximum height of 110 ft and a total concrete volume of 80,000 cu yd. The maximum discharge capacity of the spillway is 100,000 cu ft per sec, obtained through seven openings 32 ft wide with a 26-ft overflow above the crest level. Piers, gates, and operating mechanisms are all exact duplicates of the Apalachia layout, and for energy dissipation a bucket-type apron, similar to that at Apalachia, was developed from hydraulic laboratory tests.

There were special design conditions at this dam, due to the unusually large amount of silt carried by the Ocoee River, most of which comes from the 40 sq miles surrounding the copper mines at Ducktown and Copperhill. In this area all vegetation has been killed by sulfur dioxide, which formerly escaped into the air during copper smelting. If successful reforestation is not carried out in the near future, the Ocoee No. 3 reservoir will be completely filled with silt after about 40 years. This possibility was considered in the design to the following extent:

1. For the stability analysis of the dam, silt load was added to water load.
2. In order to prevent silt from entering the power conduit for as long a time as possible, a sluice channel was built immediately below the conduit intake, with gates through the dam 20 ft below the sill of the intake.
3. Provisions have been made, for the time when this sluice arrangement becomes ineffective, to by-pass the intake through a desilting basin to be built below the dam, if and when conduit and turbine maintenance should make it necessary.

APALACHIA CONDUIT

By far the most costly items of these projects are the conduits between dam and power house. As their hydraulic capacities affect initial cost and power generation to a great extent, careful studies of costs and power output were made to arrive at the optimum conduit size.

At Apalachia Dam the average river discharge is about 2,200 cu ft per sec. With 760,000 acre-ft of controlled storage available at upstream dams, only a small part of the total runoff would be wasted during floods. Discharge control studies indicated that a turbine installation using about 2,600 cu ft per sec at average gross head and at best efficiency should be selected.

The length of conduit between intake and power house is 44,043 ft, of which approximately 1,600 lin ft is open penstock sections and the remainder, tunnel sections. Based on a return of 2 mills per kwhr, best economy was

OCOEE DAM NO. 3—SLUICEWAY, AT RIGHT, REMOVES SEDIMENT FROM TUNNEL INTAKE AREA

obtained with a tunnel area of about 260 sq ft for a concrete lined tunnel ($n = 0.013$), or about 490 sq ft for an unlined tunnel ($n = 0.033$ on gross area). The lined section was adopted because, at about equal cost, greater safety in operation and greater assurance against water losses were obtained. However, an exception was made in a stretch 6,000 ft long near the upper end of the conduit, where pressures are relatively low and the rock is exceptionally good.

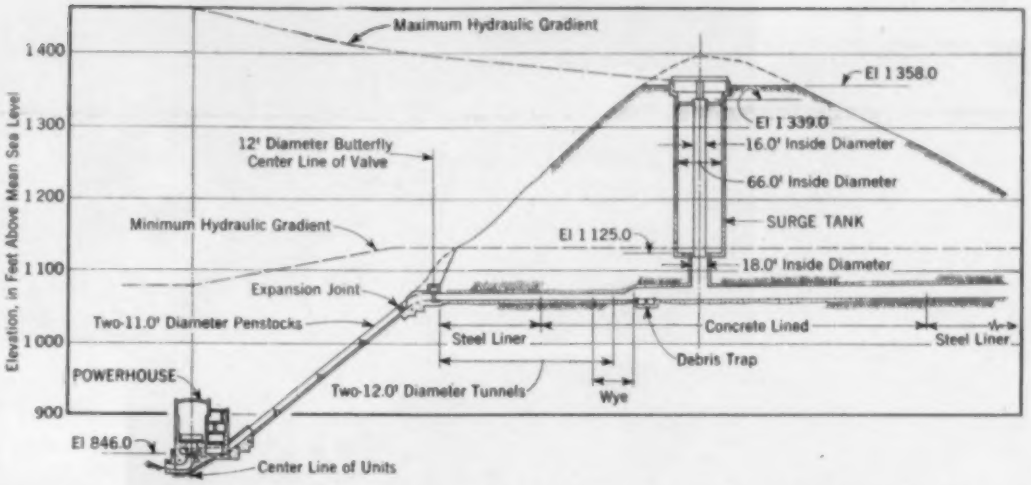


FIG. 2. SECTION THROUGH POWER HOUSE, PENSTOCKS, AND SURGE TANK, APALACHIA PROJECT

The tunnel is driven through the mountain forming the left, or south, bank of the river, where the rock is predominantly quartzite and slate. Several small tributary streams, approaching the main river between the dam and the power house, cut deeply into the mountain slope, and this topographical condition was utilized in planning the tunnel. The alinement and profile were so chosen that, through most of the tunnel, cover exceeds one-half the maximum dynamic head, the amount considered necessary for use of a non-reinforced tunnel. Actual cover averages about 300 ft with a maximum of 500 ft.

STEEL LINERS USED

At three tributary streams the tunnel passes just below the stream bed, and at Turtletown Creek, the largest tributary, well above the stream bed. These four points provided construction access to the tunnel. At two other points tributary streams cut so deep that sufficient cover for a non-reinforced tunnel could not be reasonably obtained. At all of these six points, steel tunnel liners were used. The liners were designed for full hydrostatic pressure until the cover was one-fourth of the maximum head, then reduced gradually to a thickness of $^7/_{16}$ in. at their ends. Liners were assembled at yards located at the tunnel adits. Liners at these adits were made 18 ft in diameter, the same as the concrete-lined tunnel; other liners were made 16 ft in diameter to permit transportation through the tunnel. The tunnel profile is at all times below the hydraulic gradient. The grade slopes slightly toward the power house, varying from 0.105 to 0.580%.

For each of the open-penstock sections, separate power-loss cost studies were made. These resulted in a diameter of 18 ft at the dam, 16 ft at Turtletown Creek, and 11 ft for the diameter of each of the two penstocks at the steep drop immediately back of the power house. The two power-house penstocks are spaced the same as the units in the power house. The wye between the single tunnel and the two 12-ft branch tunnels leading to these penstocks is located in the hill back of the power house, where sufficient cover for non-reinforced construction is available.

The great length of the conduit made a surge tank ahead of the power house indispensable. The desirability of maintaining the same operating characteristics for these units as obtain elsewhere in the TVA system required that the tank design take care of a 100% demand load with minimum pool level, and a 100% load rejection with maximum pool level, with a net governor traveling time of 5 sec. The differential surge tank designed for these conditions has a tank diameter of 66 ft and a riser diameter of 16 ft. The water level fluctuates over a range of about 200 ft.

An interesting feature of the tank is the design of the ports between riser and tank. The port area required for best performance for the load-on condition is far greater than that for load-off. By developing in the hydraulic laboratory a port shape which produces different discharge coefficients for flows in opposite directions, a fixed port could be used. Paul F. Kruse, M. Am. Soc. C.E., was consulting engineer on the hydraulic design of the surge tanks for both projects.

For a tank of the large size required, it was important to find a location where a steel structure would not be required. This consideration carried much weight in the selection of the power-house site. The adopted site allowed open excavation of the tank pit from the top of the ridge back of the power house. Sound rock extends above static water level. The pit is lined with concrete, and the upper rings near the surface are substantially reinforced.

All penstock sections are of welded construction. They are of the ring-girder design with rocker supports spaced approximately 70 ft center to center, and without intermediate stiffeners. There is an expansion joint in each penstock.

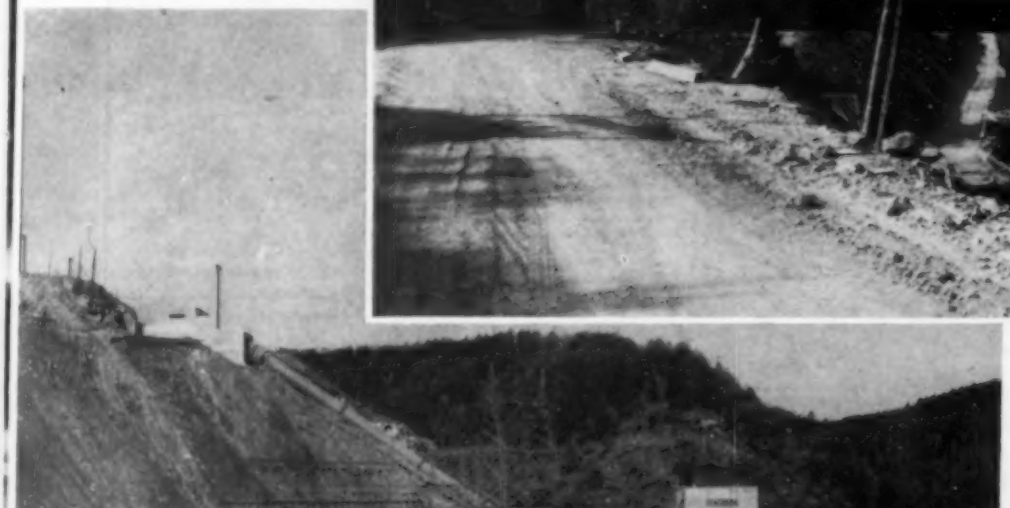
The head loss in the conduit for a flow of 2,600 cu ft per sec amounts to 60 ft, or 14% of the normal gross head of 425 ft, with the velocity in the prevailing 18-ft-diameter concrete-lined section ($A = 254$ sq ft) equal to 10.2 ft per sec. Building of the tunnel required about 620,000 cu yd of rock excavation; 205,000 cu yd of concrete for tunnel and surge-tank lining; and 92,000 bags of cement for grouting. Penstocks and steel tunnel liners required about 4,500 tons of steel.

OCOEE PROJECT SMALLER

At Ocoee No. 3 Dam the average flow is 1,270 cu ft per sec. Upstream storage amounts to 183,000 acre-ft. However, storage regulation includes only 233 sq miles of the total drainage area of 496 sq miles, so that the relative wastage of flood water is higher than at Apalachia. The power installation was selected to obtain best efficiency for a flow of 1,200 cu ft per sec at an average gross head of 305 ft.

The total length of the conduit is 13,370 ft, all in tunnel section except for the penstock. The tunnel

OCOEE NO. 3 POWER HOUSE, WITH STEEL SURGE TANK ON HILL AT LEFT



CONDUT CROSSES CREEK IN 16-FT-DIAMETER STEEL PENSTOCK, BETWEEN TUNNEL SECTIONS

pierces the mountains at the left side of the river in a straight line, through formations of hard slate and quartzite. For most of the length, cover over the tunnel is very ample, allowing the use of a non-reinforced concrete-lined section. From tunnel-cost and power-loss studies, the area of the tunnel was determined as 110 sq ft. For convenience in construction, a horseshoe section with 12.5 radii was chosen. The minimum thickness of the concrete lining specified was 6 in.

At two stretches the cover is insufficient for non-reinforced tunnel lining. The first is at the intersection with Rough Creek, where a 12-ft-diameter steel liner is encased in a concrete lining, which forms the overflow weir for the creek. This point also served as a construction adit. The second steel-lined section was required near the adit above the power house. The tunnel profile remains always below the minimum hydraulic gradient, and slope varies between 1.1 and 0.67%. The power-house adit opens 180 ft above the river level, and an exposed steel penstock 11 ft in diameter, of ring-girder design, connects with the turbine below.

The differential surge tank required a tank diameter of 40 ft and a riser diameter of 10 ft 6 in. The extreme fluctuations extend over a range of 130 ft. Similar to Apalachia, the coefficient of discharge for the ports between the riser and the tank are different for water flowing in opposite directions. Topographic conditions at the site and economy led to the adoption of a steel tank, 148 ft high, founded on a concrete mat.

For control of conduit flow, a single gate, 12 by 12 ft, with fixed rollers and individual hoist, is installed at the intake. At the upper end of the power-house penstock, there is a butterfly valve 12 ft in diameter. The head loss in the conduit for a flow of 1,200 cu ft per sec amounts to 24 ft, or 8% of the normal gross head of 305 ft. The corresponding velocity in the typical tunnel section (A = 110 sq ft) is 10.9 ft per sec.

COMPACT POWER-HOUSE LAYOUTS

Because of the relatively large head available, the physical dimensions of the generating units at these two projects are small compared with other TVA installations. In the layout of the power houses, this advantage was retained by close grouping of all main features, and by condensing the space for auxiliary features as far as good operation and maintenance would allow.

At Apalachia the power installation consists of two units, each rated at 53,000 hp at 360-ft net head, operating at a normal speed of 225 rpm. The turbine setting is conventional with elbow draft tube and cast-steel scroll case. The throat diameter of the runner is 8 ft 7 in. The spacing of the units is 44 ft. The generator room is of the indoor type with a crane span of 40 ft 6 in.; the electrical equipment is housed in an extension of the building up the hill on the upstream side. The control room is on the level of the generator room floor, and the actuator cabinets are moved into the control room, flanking the main control board. A service bay at the downstream end provides space for erection, for a machine shop, and for some items for station service. Concrete in the power house totals 12,500 cu yd.

The chosen power-house location—at the foot of a steep cliff where any substantial encroachment on the width of the river would cause undesirable backwater effects—put many limitations on the disposition of switchyard and access facilities. These limitations were aggravated by the presence of a through railroad track along the river shore. A satisfactory solution was found by placing rock fill, protected by heavy riprap and concrete toe walls, upstream and downstream from the power house. The triangular area on the downstream side is used for road and railroad access and for parking. The upstream area forms the transformer yard. Space for the switchyard was secured by cutting off the top of the hill in which the surge tank is located, and the excavated material was used to build the fills adjacent to the power house. Control cables from the power house are encased in a concrete envelope between the penstocks below the valve house, and in exposed transite conduits on steel supports above the valve house. Three 154-kv transmission lines connect the station initially to different key points in the power system.

At Ocoee No. 3, one single unit rated at 33,500 hp at 280-ft net head, operating at a speed of 200 rpm, is installed. The generator room is of the enclosed type with a crane span of 36 ft 6 in. The power house is built as a single block approximately 68 ft by 96 ft. To assure economy, the power house is operated by remote control from the plant immediately downstream on the Ocoee River. As the river bed at the power house is relatively wide, the large area required for switchyard and access facilities could easily be provided by filling tunnel muck into the original river bed upstream of the power house.

Army Specialized Training Program for Civil Engineers

By HERMAN BEUKEMA, COLONEL G.S.C.
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THE objective of the Army Specialized Training Program, which was established on December 18, 1942, by Lt. Gen. Brehon B. Somervell, Commanding General of the Army Service Forces, upon the direction of the Secretary of War, is to meet the need of the Army for specialists and technicians to perform the many tasks necessary in modern battle.

To that end, the Army has contracted with selected colleges and universities to give such training to qualified soldiers in courses prescribed by the Army. At the end of August, more than 100,000 soldiers were in training in the Program at 209 colleges and universities, while 16,000 others were at Specialized Training and Reassignment (STAR) Units at which final determination is made as to whether a soldier is qualified.

Fourteen hundred enlisted men were pursuing civil engineering studies under the Army Specialized Training Program at 34 colleges and universities on August 14. More than 30,000 men were taking basic-phase courses in the Program at 85 colleges and universities at that time. Completion of the basic work, plus the other necessary qualifications, may lead to training in the Advanced Phase of the A.S.T.P.

In picking its men for these special fields of training, the Army has interviewing boards, known as A.S.T.P. Field Selection Boards. These boards are located at all camps, posts, and stations.

In order to be considered for the Program, soldiers must have scored 115 or above in the Army General Classification Test, and they must meet certain other eligibility requirements. Soldiers meeting the general qualifications are recommended for the Program by the Field Selection Boards. On completion of their basic military training, they are sent to a STAR unit where they are interviewed, tested and then, if found qualified, assigned to a specific course of study in the highest term for which they are suited. The trainees are then sent to an Army Specialized Training Unit at an institution participating in the Program.

These trainees are soldiers on active duty. Civilian instructors have charge of academic instruction while the officers of the A.S.T. Unit supervise the military phase of the Program.

Curricula for the courses were prepared under supervision of the Army Specialized Training Division. For the actual drafting, the American Council on Education was requested to submit lists of outstanding teachers in each of the fields covered by the Program. The American Council, in turn, called on other accrediting agencies such as the Society for the Promotion of Engineering Education to assist in the preparation of panels. With very few exceptions, all participating personnel were drawn from such lists.

The completed curricula were submitted to and approved by the various Arms and Services of the Army which are scheduled to receive the trainees at the completion of their courses. Finally, the Army Specialized Training Division submitted such curricula to its Advisory Committee, consisting of the presidents of ten leading colleges and universities.

In the opinion of the Advisory Committee, A.S.T.P. curricula are at the college undergraduate and graduate level. The Committee held, moreover, that all courses are worthy of full college credit but deemed it advisable to leave the decision in such matters to the college authorities. In particular the Committee had in mind the prospect of the trainees returning to college after the war to complete their education and to secure their degrees.

A.S.T.P. curricula include the following: Aeronautical Engineering, Chemical Engineering, Civil Engineering, Electrical Engineering (Communications and Power), Mechanical Engineering, Aeronautical Engineering, Sanitary Engineering, Marine Transportation, Medicine, Dentistry, Veterinary Medicine, Personnel Psychology, Languages, Foreign Area Study, Military and Physical Training, Acoustics and Optics, Internal Combustion Engines, and Surveying. The courses are arranged for presentation in quarters of twelve weeks each, with a gap of one week between quarters.

PROGRAM DIVIDED INTO TWO PHASES

The Program is divided into two phases, basic and advanced.

The basic phase covers work that begins at the college freshman level. It carries through the first half of the sophomore year. In general, it is a prerequisite to training at the advanced phase for all trainees whose prior education falls short of requirements for the advanced phase. It comprises three twelve-week terms, roughly nine calendar months.

The advanced phase covers academic work that begins at the second half of the sophomore year. In some courses, the work is at the postgraduate level. There are from one to four twelve-week terms in the advanced phase, depending on the course of study. An exception is the medical course, which is longer.

Training in engineering takes place in three basic-phase terms and in one or more advanced-phase terms, depending on the branch of engineering in which the soldier is being prepared.

Trainees selected for basic-phase instruction in engineering are assigned to pursue one of two plans of study as follows:

Plan One. This involves three terms of basic-phase studies with specialization in one of the following: general physics, communications, mechanics, or surveying. These curricula are not designed as preparation for advanced-phase work. Instead under this plan the soldier's specialized training program is expected to terminate at the end of Term III.

THE vital part that civil engineers play in high-powered modern warfare has been aptly demonstrated in World War II. Military experts credit the Corps of Engineers of the United States Army with not only doing a "fighting job" but working smoothly under desperate conditions and turning in an expert and workmanlike performance. Credit for the ability of the engineers lies in thorough training. The demand for specialists and technicians in the Corps of Engineers was one of the factors responsible for the establishment of the A.S.T.P., here described.

Plan Two. This involves three terms of basic-phase studies commonly preparatory to advanced-phase studies in one of several specialized branches of engineering. For trainees whose prior education falls short of requirements for the advanced phase, the basic phase is a prerequisite. The trainee is admitted to the highest term for which he is found qualified.

Advanced-phase engineering studies are in highly specialized fields. Trainees in this phase are assigned to studies in a particular branch of engineering. These advanced-phase curricula range from one to four terms. They are as follows:

Civil Engineering, three terms; Mechanical Engineering, three terms; Electrical Engineering, four terms (the trainee specializes in either Communications or Power Engineering in the final two terms); Chemical Engineering, four terms; Sanitary Engineering, four terms (an additional term is prescribed for trainees preparing for assignments in this field in the Medical Department); Marine Transportation, and Aeronautical Engineering, one term each (following the advanced phase terms in another branch of engineering).

BASIC-PHASE CURRICULA

The basic-phase curricula include curriculum BE-1, the primary basic curriculum, and four other curricula specializing in surveying, internal combustion engines, communications, acoustics, and optics.

Curriculum BE-1 contains three terms of mathematics (through an introduction of differential calculus); three terms of physics (comparable to one year of college physics for engineering students); two terms of chemistry; one term of engineering drawing, and three terms of English, history, and geography. A total of 24 contact hours per week is scheduled in the above courses. To this total are added five hours of military training and six hours of physical training. The following tabulation gives the details of the basic-phase curriculum:

Term 1:	HRS. PER WK
Mathematics (College Algebra and Trigonometry)	6
Physics	7
Chemistry	3
English	3
History	3
Geography	2

Term 2:	HRS. PER WK
Mathematics (Analytical Geometry)	5
Physics	7
Chemistry	6
English	2
History	2
Geography	2

Term 3:	HRS. PER WK
Mathematics (Differential Calculus)	5
Physics	7
Engineering Drawing	6
English	2
History	2
Geography	2

To meet the specialized needs of the Army Ground Forces, the primary basic curriculum was modified to give one of the specialties desired. For Curriculum BE-2, a one-term course in plane surveying and a one-term course in topographic surveying and mapping replace chemistry. A course in aerial mapping replaces engineering drawing. In the other specialized basic curricula similar substitutions have been made for chemistry and engineering drawing in order to achieve the desired results.

The engineering curricula in the advanced phase have been developed to give the student a sound knowledge of those subjects which are of immediate military use. Many courses traditional to a given field have been eliminated because of the limited time available for training. Thus in the Civil Engineering curricula many of the advanced design courses have been omitted. The advanced-phase Civil Engineering curriculum is as follows:

Term 4:	HRS. PER WK
Mathematics (Integral Calculus)	5
Mechanics	6
Surveying (Elem.)	6
Elements of Electrical Engineering	8
Engineering Drafting—Structural Drafting	3

Term 5:	HRS. PER WK
Strength of Materials	4
Material Testing Laboratory	3
Stress Analysis	5
Fluid Mechanics	4
Surveying—Advanced	5
Internal Combustion Engines	6

Term 6:	HRS. PER WK
Structural Design	7
Water Supply and Sewerage	6
Transportation	6
Foundations	6
Engineering Drafting—Topography Drafting	3

Specially selected students who have completed the Civil Engineering curriculum may be assigned to continue their instruction for one or two additional terms in Sanitary Engineering. Following is the Sanitary Engineering Curricula:

Term 7:	HRS. PER WK
Treatment of Water	7
Sewage Treatment and Disposal	7
Hydrology	2
Drainage	2
Sanitary Bacteriology	4
Sanitary Chemistry	4
Sanitation and Military Preventive Medicine	3

Term 8:	HRS. PER WK
Parasitology	6
Sanitary Conference	4
Advanced Sanitation	4
Epidemiology	3
Advanced Sanitary Chemistry	3
Advanced Sanitary Bacteriology	6

To provide training for men who are found to have had training equal to or above that offered under the A.S.T.P., a curriculum limited to a single term has been established. Trainees in this curriculum are prepared to meet immediate demands on the A.S.T.P. for advanced technicians. Some require only refresher instruction; others need a brief course of specialized training to enable them to serve more effectively in important assignments. In view of the diverse backgrounds of the trainees assigned to this curricula, no rigid course work is prescribed.

The A.S.T.P. institutions offering civil engineering at the present time are:

Massachusetts Institute of Technology
New York University
Rutgers University
Lehigh University
Pennsylvania State College
University of Pennsylvania
College of the City of New York
Carnegie Institute of Technology
Virginia Military Institute
North Carolina State College
Michigan State College
South Dakota State School of Mines
State University of Iowa
Georgia School of Technology
University of Florida
Ohio State University
Purdue University
Rose Polytechnic Institute
University of Kentucky
West Virginia University
University of Michigan
University of Minnesota
University of Mississippi
University of Wyoming
Agricultural and Mechanical College of Texas
Texas Technological College
University of Oklahoma
Oregon State Agricultural College
Stanford University
University of Idaho
University of Santa Clara
State College of Washington
Syracuse University
University of Arizona

Others will be added.

Navy Develops All-Timber Blimp Hangar

Part I. Unprecedented Design Problems Encountered

By ARSHAM AMIRIKIAN, M. AM. SOC. C.E.

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RISING 153 ft from the concrete floor, timber arches carry a timber roof protecting a 7-acre dock for the Navy's "sub"-hunting blimps. The several hangars that have already been erected are said to be the greatest timber structures ever built. In the design of the trussed arches, for instance, certain structural data were completely lacking for framing of such size. This article, discussing the unusual details of design, will be followed by a record of construction procedure, also by Mr. Amirikian.

SINCE the early days of mankind, wood has played a prominent part in the human struggle against the elements. Not only was it burned to provide warmth, it also served as the first construction material for shelter and to bridge a gap or water barrier. Thus it is natural that, in the present global conflict, when the available supply of steel is necessarily reserved for the construction of ships and weapons of combat, we should once more resort to wood for structures essential to the war effort. Thus some unusual problems arose.

In the case of most buildings comprising naval shore facilities, the shift from steel to wood as a material of construction did not create a serious problem either in design or construction. However, while it was relatively a simple matter to devise a timber framing for a storehouse, a barrack, or a hospital, the task of substituting wood for steel in the framing of an unusual structure, such as an airship dock, appeared at first quite difficult and of doubtful practicability. Some of the difficulties were due to the lack of complete structural data on certain phases of the design; others were traceable to the unprecedented nature of the framing and the related problems of detailing, fabrication, treatment, and handling of the material in the field.

Under normal conditions, such a project would have required considerable research and experimentation prior to the actual design. However, in the accelerated public works program of the Navy, there was little time or opportunity for the application of peacetime procedure. Consequently a great number of these hangars were scheduled for early completion at various coastal points in the country, thus necessitating a design in short order. The designs of the hangars were completed in the fall of 1942, and by August 1943 the majority of the buildings were completed or were nearing completion as scheduled.

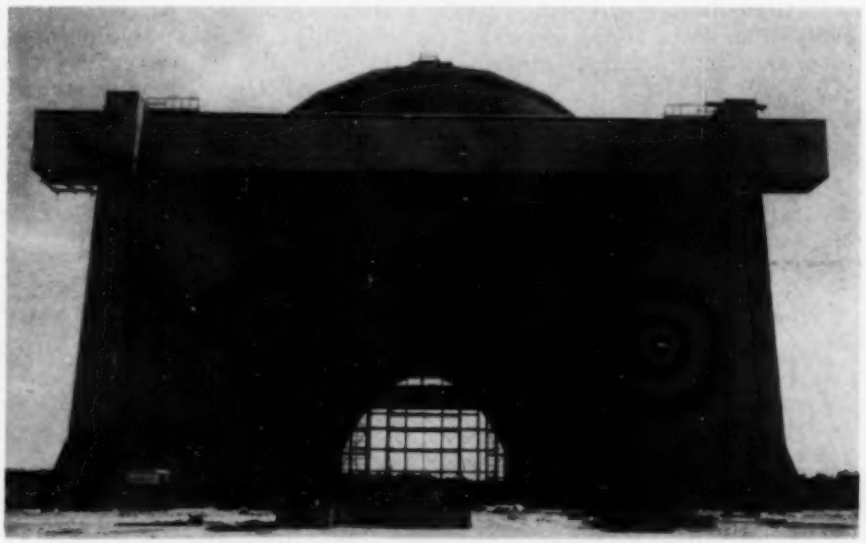
EGG-SHAPED ROOF SHELL

These new airship hangars or docks of timber framing are designed to provide shelter and render overhaul service to blimps of the coastal patrol. Essentially, the building consists of an egg-shaped roof shell, stiffened with a series of transverse arch ribs, and two end doors. The shell is 1,000 ft long, 170 ft high at the crown, and has an overall width at the ground level of about 296 ft. The lower 24-ft section of the shell skirts the lean-to framing which provides shop and office space. In each half-shell there are an overhead 2½-ton trolley running longitudinally at a height of 137 ft, a longitudinal catwalk at about the same level, a stairway at each end (leading to the catwalk and the roof), and a stairway at the middle, ending at the catwalk level. The end doors are of two types—some hangars are provided with vertical flat-leaf, sliding, folding doors and a supporting tower bent, while others have one-piece, semi-dome-shaped, self-supporting doors (Fig. 1). While to date these huge structures comprise the world's largest buildings of timber framing, both from the standpoint of dimensional magnitude and of the materials involved, they do not necessarily represent the limit of wood construction.

In appearance as well as in dimensional proportions, the cross section of an airship dock presents a rather unique outline (Fig. 2). The main consideration in the development of such a cross-sectional outline is, obviously, the requirement of operational clearance for the ships to be housed. This cross-sectional clearance is given by a rectangle 220 ft wide and 120 ft high.

While hangars for rigid airships, requiring considerably larger cross-sectional clearances and utilizing steel or reinforced concrete framing, have been successfully built here and abroad, for a timber framing this clearance of 220 by 120 ft had no precedent. Before selecting the final framing arrangement, it was natural therefore to proceed with the design studies with great caution.

After due consideration had been given to several framing arrangements, an inverted catenary arch with rigidly connected supports was the design adopted. The clear span of the arch at the top of the abutment bents is 234.5 ft, and the clear height at the crown is about 157 ft from finished floor grade. While these dimensions appear some-



END VIEW OF NAVY BLIMP HANGAR SHOWS MULTIPLE-LEAF SLIDING DOORS

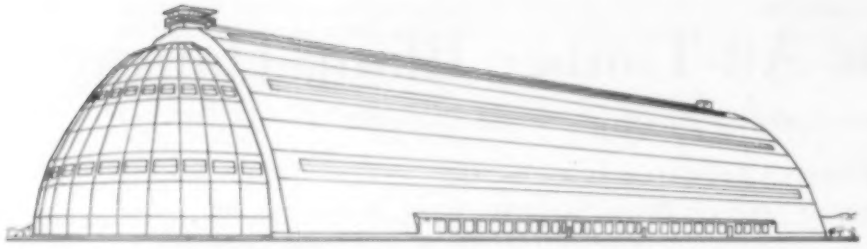


FIG. 1. VIEW OF HANGAR AND SEMI-DOME DOOR

what larger than the specified minimum clearance, the divergence is due to the necessity for adapting the outline to the most favorable stress path of the arch thrust.

Arch ribs are of the open-web trussed type (Fig. 2), with partly parallel and partly diverging chords. In the upper sections of the rib the depth is constant, the two chords being parallel with a spread of 13 ft 6 in.; while in the lower sections the depth varies as the chords diverge to a maximum spread of 19 ft at the abutment. The chords are two panels long, the panel length in the upper and lower chords being about 12 and 11.5 ft, respectively. Thus the change in the arch curvature occurs at every other panel. The web verticals are normal to the arch axis, with a working length of 13 ft 6 in. between the parallel portion of the chords, and a maximum length of 17 ft near the abutment. The working length of the diagonals between the parallel chords is about 17.5 ft, increasing in the lower sections of the rib to a maximum of 21.5 ft for the last diagonal at the abutment. The chords and the diagonals have two-member sections for spaced column arrangement, while the web verticals consist of single members. In size, the chords vary from two 3 by 12-in. to two 4 by 14-in.; the diagonals from two 3 by 8-in. to two 4 by 16-in.; and the web verticals from one 4 by 8-in. to one 6 by 18-in.

The arch ribs are spaced 20 ft on centers, with a longitudinal purlin truss at each panel. The purlin truss consists of a 3 by 10-in. upper chord or the purlin, two diagonals which act as sway bracing between the arches and provide an additional support for the purlin at midspan, and a bottom chord serving as strut in the bottom-chord plane of the arch ribs. Roof sheathing, consisting of 2-in. tongue-and-groove planking, spans in the longitudinal direction, resting on 3 by 12-in. rafters placed 6 ft 8 in. on centers, which in turn are directly supported by the 3 by 12-in. purlin trusses.

In the bottom chord plane there is a cross bracing in every other bay. In the top chord the sheathing constitutes the main bracing, supplemented by a system of V-bracing in the lower three-quarters of the arch periphery. This V-bracing, which is placed in the top plane of the purlins, serves also to keep the purlines from sagging in the steeply sloping parts of the roof.

Ribs are anchored to concrete abutment bents at the base. The choice of concrete bents instead of timber framing was dictated by the clearance requirements of the lean-tos. These trapezoidal bents of rather slender proportions provide unobstructed shop space under the abutments and transmit the arch thrust to the foundation.

Since the hangars are located at different stations, the design loading varied rather widely, consisting at the most favorable locality of the basic dead load, a $2^1/_2$-ton trolley at two panel points, and a wind of 70 miles per hour. At other stations, it also included a snow load varying from 20 to 40 lb per sq ft; at still others it was necessary to consider earthquake effects and increased wind pressure, corresponding to velocities up to 100 miles per hour. The earthquake loading was assumed to be one-tenth of the gravity loading.

In the case of the lighter framing, the roof dead load, including arch rib and bracing, averaged about 14 lb per sq ft of roof periphery, while in the heavier designs this increased to about 15 lb per sq ft. Distribution of wind and snow loading on the building, as used in the design, is shown in Fig. 3.

In obtaining the maximum design stresses for various members of the framing, various combinations of loading were used. In general, the maximum stresses in the arch members were governed by the dead load plus wind combination. However, in localities where heavy snow prevailed, the dead load plus snow plus wind combination governed the design of most of the members.

Two grades of structural timber were specified in either Douglas fir or southern pine. One had a fiber stress of 1,400 lb per sq in. and the other of 1,200 lb per sq in., graded in accordance with the regional lumbermen's association rules. The former was utilized in the chords and webbing of the arches, and the latter for the rest of the framing. The allowable working stresses for each grade, as used in the design, are as follows, in pounds per square inch:

ITEMS	1,400 *f*	1,200 *f*
Extreme fiber in bending	1,400	1,200
Compression with grain	1,100	1,000
Compression across grain	380	325
Horizontal shear	120	100

Except for load combinations involving earthquake, no increases were made in these allowable stresses when designing arch rib members for maximum stress. When earthquake loads were considered, the working stresses were increased by 25%. Allowable stresses for purlins, rafters, bracings, and sheathing were increased by 50%

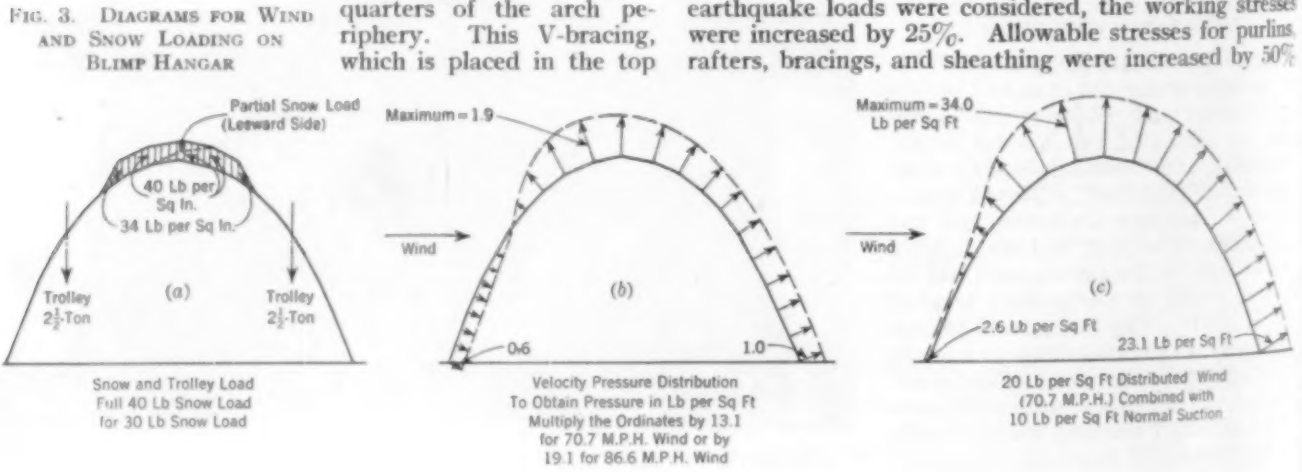


FIG. 3. DIAGRAMS FOR WIND AND SNOW LOADING ON BLIMP HANGAR

for maximum stresses due to the load combinations involving wind.

With few exceptions, the design of all arch rib members was governed by the l/d (span length to least-side dimension) ratio of the individual members, acting as axially loaded columns in the Euler range. The limiting values of l/d, end restraint, and safety factors, and the resulting allowable unit stresses were in accordance with the specifications of the National Lumber Manufacturers Association, as given in "Wood Structural Design Data. Supplement No. 4."

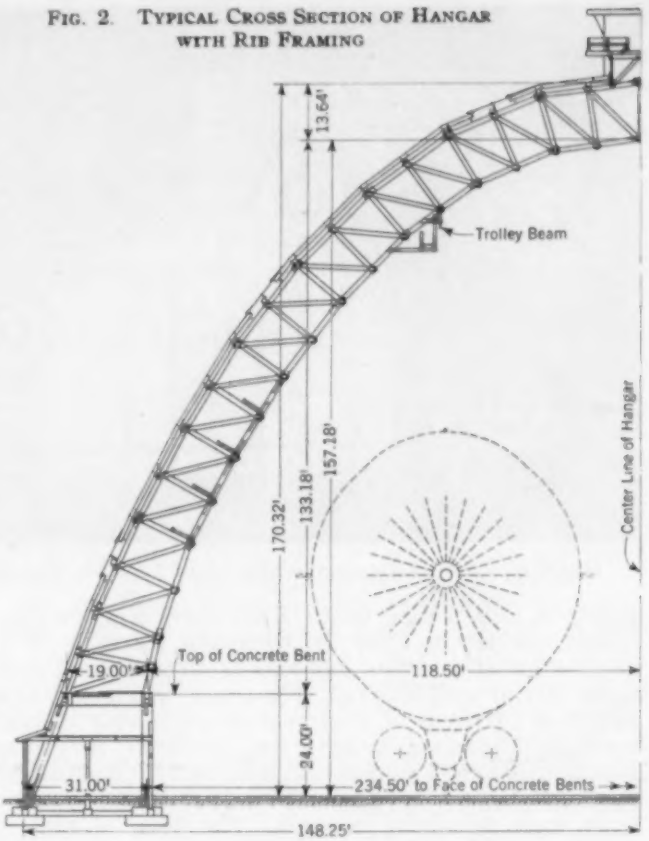
The importance of connections in a timber framing cannot be overemphasized. It is safe to state that the extent of utilization of timber as the main material of construction in a major structure is largely, if not entirely, dependent on the availability of a connecting device which possesses simplicity of arrangement and adequacy as regards strength, and requires a minimum amount of critical material. To this end, the introduction of "timber ring connectors" constitutes a noteworthy contribution to the timber construction industry. For connections in the blimp dock framing, both split rings and shear plates were used—the former in all preassembled units, and the latter in field splices.

In providing enclosures for the huge openings, it was necessary to divorce the door framing from the main building so that additional (dead and wind load) pressures would not be imposed in the longitudinal, inherently weak direction of the framing. Despite generous use of longitudinal chord bracing, this framing could not resist either the wind pressures on a flat door over 275,000 sq ft in area, or the large dead-load thrust of a so-called "orange-peel" revolving door generally used for steel hangars of similar outline. With this design limitation, two types of door framing were considered: (1) a flat sliding door with a separate supporting arrangement, and (2) a self-stable revolving door of spherical contour.

The flat sliding door is of the familiar type generally used in airplane hangars. It consists of six door leaves, three units at each side of the opening, supported by a tower bent. Prior to the design of these hangars, the largest door of similar type was one utilized in a Navy repair and overhaul shop, which had an opening clearance 90 ft high and 155 ft wide. In comparison, the door-opening clearance of the new timber blimp hangars measures 120 ft high and 220 ft wide. In addition, the new design differs from the former arrangement in having an independent supporting framing, separated from the main building. Timber, steel, and concrete are combined in the door structure.

Each leaf of the sliding door is about 27 ft 6 in. wide, 120 ft high, with a depth or thickness varying from 3 ft 6 in. to 5 ft 3 in., according to the type of the framing and the location of the hangar. The framing has a rectangular cross-sectional outline, composed of a system of vertical and horizontal trusses, supplemented by girts, sash, and sheathing in the outer face, and bracings in the inner face. The vertical trusses, which constitute the main load-carrying members of the framing, number two in some designs and four in others. In general the trusses, girts, and bracing are of steel and have welded connections. In one design, however, all the steel members of the framing, except the chords of the vertical trusses, were replaced by timber sections.

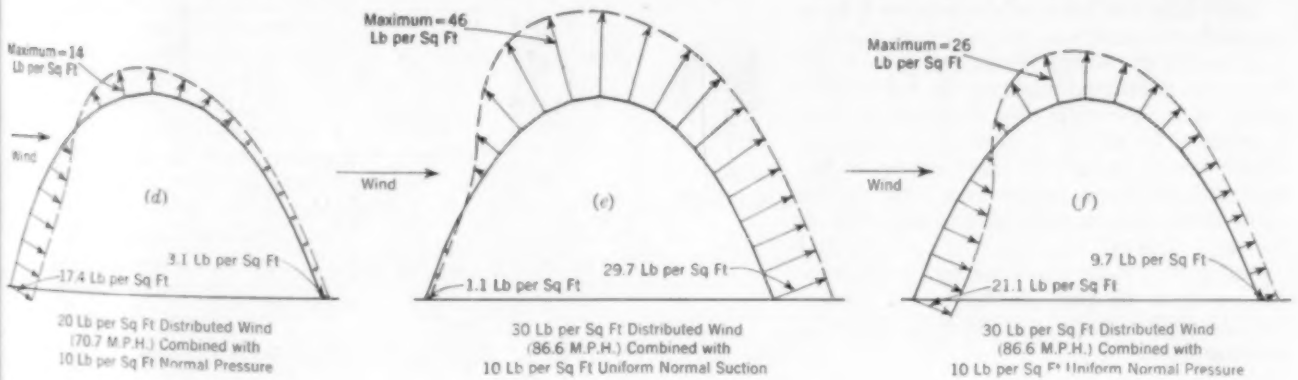
FIG. 2. TYPICAL CROSS SECTION OF HANGAR WITH RIB FRAMING

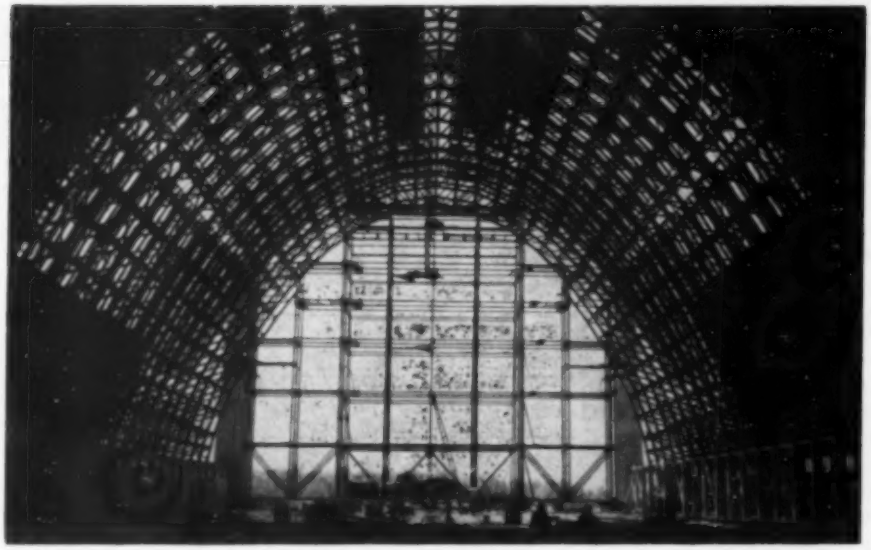


The door leaves, in their assembled position, are mounted on two-wheel carriage trucks moving on parallel rails, and are laterally supported at the top on a set of rollers, supported in turn by guides fastened to the overhead door girder. The weight of each door leaf varies from 26 to 39 tons, according to the type of framing and the location of the hangar.

Each group of three leaves is operated simultaneously by a cable arrangement. The motive power is supplied by a two-speed motor of 7.5 to 10 hp. The maximum speed of door operation is 75 ft per min, making it possible to open or close the doors in less than two minutes.

The door-supporting bent is composed of an overhead box girder and two supporting towers, connected to-


Maximum = 14 Lb per Sq Ft
Wind
(d)
3.1 Lb per Sq Ft
17.4 Lb per Sq Ft
20 Lb per Sq Ft Distributed Wind (70.7 M.P.H.) Combined with 10 Lb per Sq Ft Normal Pressure
Maximum = 46 Lb per Sq Ft
Wind
(e)
29.7 Lb per Sq Ft
1.1 Lb per Sq Ft
30 Lb per Sq Ft Distributed Wind (86.6 M.P.H.) Combined with 10 Lb per Sq Ft Uniform Normal Suction
Maximum = 26 Lb per Sq Ft
Wind
(f)
9.7 Lb per Sq Ft
21.1 Lb per Sq Ft
30 Lb per Sq Ft Distributed Wind (86.6 M.P.H.) Combined with 10 Lb per Sq Ft Uniform Normal Pressure



INTERIOR VIEW OF HANGAR WHEN MAIN FRAMING HAD BEEN COMPLETED

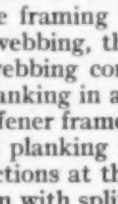
gether to form a rigid bent. Each tower has two legs, spaced laterally to clear the three-unit leaves in their open or folded position, and acts as an individual bent under lateral wind loading. The tower, which rises to a height of 147 ft, is of reinforced concrete with cellular framing. The legs of the tower are 120 ft high; they have a rectangular cross section 12 ft wide by 17 ft deep at the base, and taper to a square 12 by 12 ft at the top, the inner faces remaining parallel. The walls of the leg cells are 12 in. thick, and are stiffened with horizontal diaphragms 10 in. thick, spaced about 17.5 ft on centers.

The box girder, measuring 21 ft $9^1/_2$ in. square in cross section, has a 220-ft 9-in. clear middle span and a cantilever span of 29 ft 5 in. at each end. The framing is composite, having steel chords and timber webbing, the latter designed to take shear only. The webbing consists of two layers of 3 by 12-in. diagonal planking in all four faces of the girder, supplemented by stiffener frames placed 7 ft 1 in. on centers. The diagonal planking is sandwiched between the two-angle chord sections at the four corners of the box, and attached to them with split-ring and shear-plate connectors. In the bottom face of the box, an additional layer of 3 by 14-in. planking is provided for anchorage of the roller guides and distribution of the lateral wind loading.

In addition to providing lateral support to the door leaves, the box girder carries the enclosure framing for the remainder of the end opening. Continuity of the box girder with the towers and the cantilevers is provided by means of chord splices and shear connections anchored into the tower walls.

TIMBER SEMI-DOME DOOR

At certain localities, where relatively poor foundation conditions prevailed, it was not practicable to use flat doors, because of the heavy concentrated loads on the tower bent piers. To cope with this situation, it was necessary to devise a new door framing which would distribute the loading to the foundations over a larger area and, at the same time, possess self-stability under gravity and lateral loading. The so-called "semi-dome" door appeared to be the logical solution of the problem. So named because of its shape, the door is half of a catenary shell.



In dimensions, framing, and operational arrangement, this semi-dome door represents in itself a unique example of timber construction. With the exception of a center assembly piece at the crown, which is made of steel in order to provide a somewhat simpler detail, the entire framing of the door is of timber. While the change to this type of door at certain stations was dictated primarily by foundation conditions, its use resulted in further savings of critical materials, to the extent of eliminating some 600 tons of structural steel per hangar. In addition it provides a pleasing contour, which has a distinct aerological advantage in excluding the occurrence of undesirable air flow at the ends while the blimps are being moored.

The door provides closure by abutting against the lower chord periphery of the end arch of the hangar. In this position, it does not exert a longitudinal pressure against the building, since it does not need external lateral support to prevent rotation or tipping. The door is 159 ft high at the crown, and its horizontal projection is a half circle with a radius of 120 ft. This circular shape has the advantage of providing duplication in framing and the necessary stability.

As shown in Fig. 4, there are 7 main meridian ribs, 8 intermediate meridian ribs, and a complete end arch rib with a box-truss tie. The main ribs are connected at the crown to a steel center piece in the form of a circular truss of 4-ft radius. The ribs have a depth of 13 ft. The details and arrangement of the ribs, bracings, and roof framing are similar to the construction of the hangar roof. At the base, the ribs frame into a skirting box girder, which in turn is supported on two-wheel trucks located at each rib. The 17 trucks of the door move on a set of 11 concentric tracks, the six outer rails carrying two trucks each. The door moves away from the end of the hangar through a 90° angle, taking a position parallel to the hangar when open. The power is supplied by a diesel-generator set of 144 hp at 1,000 rpm, mounted on two trucks located near the center of the skirting girder.

The door is driven by 11 of the 17 trucks, with $7^1/_2$-hp direct-current motors, designed for parallel operation. It can be operated at three speeds, ranging from 10 ft per min to 62.5 ft per min, and requires approximately 10 minutes to move from its closed position to a fully open position parallel to the hangar.

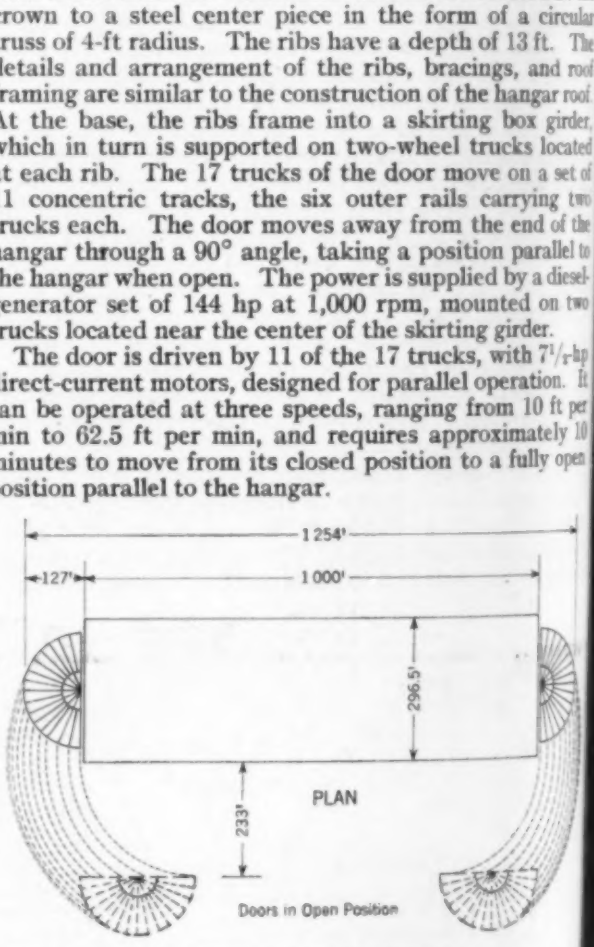


FIG. 4. PLAN OF SEMI-DOME DOOR FRAMING

Water and the 1941 Drought in Georgia

Some Practical Hydrologic Possibilities, Condensed from Presentation Before Georgia Local Section

By M. T. THOMSON, ASSOC. M. AM. SOC. C.E.
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ACCORDING to an old adage, "We never miss the water till the well runs dry." This is a strange paradox, for in our daily lives we use more water than all other substances combined; our bodies are 97% water; our food is more than half water; our precious coffee is really only flavored water. Every day each of us uses an average of 50 gal at home—that 50 gal is 400 lb. In comparison, our coal furnace uses only about 20 lb of coal per person per day, and our food amounts to about 4 lb per day.

Enormous quantities of water are needed to produce some of the things used in homes. It is estimated that it takes something like 200 lb to produce the electric power a person uses each day. A half-pound helping of beef represents 30,000 lb of water required for the steer to drink and for raising the grass he lived on. A helping of potatoes represents 100 lb of water—a slice of bread, 300 lb. To make the paper from wood for a daily newspaper requires 50 lb of water, not to mention the 500 lb or more the tree consumed to produce the wood.

These figures are rough approximations, not intended to be used for scientific purposes. They do, however, indicate the importance of water in our daily lives.

Nature provides a water-supply system for trees and crops, through rain and ground storage with more or less help from us. For both personal and industrial uses we have to do a lot of work and expend a lot of money to get the water, to bring it to where we need it, and to dispose of it after we are through with it. This business of supplying fresh water and disposing of waste and storm water is one of the biggest industries in the country.

Throughout the war effort we have heard of bottlenecks. First, it was aluminum, then steel, then power, then transportation. Now it is labor and food. In every one of these problems water has been an important factor, though only rarely was it the critical factor, thanks to the ability of engineers to adapt nature's supply to our needs, or more often to adapt our use to the available supply.

The following are rough approximations:

1. For every ton of steel produced, 18,000 gal of water are necessary. It takes a glass of water to make one sixpenny nail. Producing steel for a medium tank takes as much water as a city of 5,000 people use in a day.
2. A barrel of water is needed to produce 1 kwhr of electric power from coal—one glassfull every 5 sec for each 1,000 w.
3. A glass of water is required to make one sheet of typewriter paper.
4. Producing $1\frac{1}{2}$ ounces of whiskey requires 20 glasses of water, but alcohol is now going into gunpowder instead of whiskey. Two and one-half glasses of water are needed to make the smokeless powder for one 30-caliber bullet—one armored division can shoot off 600 tons of ammunition a day. The water needed to make the powder used would supply a city of 50,000 people for one day.
5. Our railroads carried something like 500 billion ton-miles of freight last year. In so doing steam locomotives consumed more water than the people of Georgia (over 3 million of them) used in their homes. One glass of water will run an average freight train 40 inches.
6. The manufacture of cloth, particularly rayon, requires enormous quantities of water—75 gal are needed in making a pound of yarn. To make the rayon in one stocking requires 110 glasses of water. A cotton mill in South Carolina had almost to double its water supply—from 4 to 7 mgd—to convert from the manufacture of domestic cloth to the same yardage of uniform cloth.

We now hear much about the importance of food production. A drought in the growing season in wartime would be a terrible disaster. The loss of crops may be even greater in proportion than the deficiency of water.

One reason why water supplies do not often hold up production is that engineers make their plans on the basis of their knowledge of water resources. The Army does not build camps or award contracts for munitions unless an adequate supply of water is assured. A site can be favorable in every respect but that of water sup-

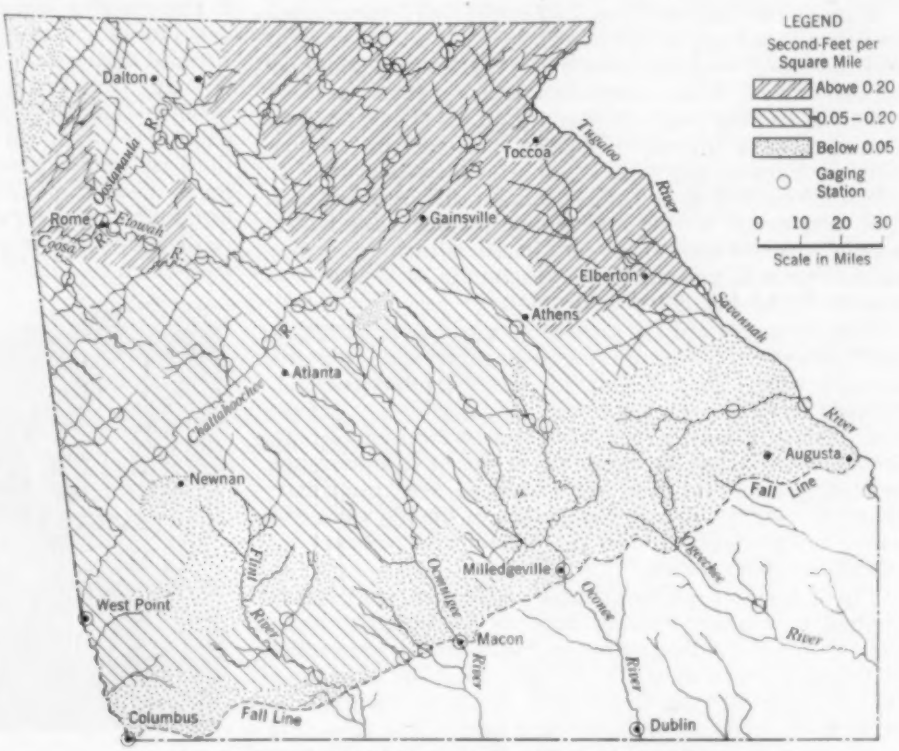


FIG. 1. ESTIMATED 1941 MINIMUM RUNOFF IN NORTH GEORGIA

ply, and still not be used. Time has been at a premium in our war effort, so contracts for materials or for the building of factories have depended to a large extent on the supply of water immediately available. The construction of dams and reservoirs could rarely be given consideration because of the lack of time, as well as material shortages.

This has meant that many communities could not sponsor war industries—not that water could not be obtained, but because it was not readily available. A huge bomber plant would not have been located near Atlanta if the city had not been able to spare several million gallons a day for its use. And the opposite condition holds true—a big powder plant might have been built in Georgia, as there were several favorable sites with respect to labor supply, transportation facilities, and other conditions, but the plant needed 35,000,000 gal a day, or nearly as much as is used by Atlanta.

Most of the military camps in Georgia are located in the coastal plain where water is readily available in artesian beds. A well can be drilled, lined with a few hundred feet of pipe, chlorinated a little, and a first-class supply is available for 10,000 men at a cost of a few thousand dollars. But in most of north Georgia where the same amount of work would rarely yield enough ground water for 500 men, the larger water supplies come only from surface streams.

Basic information as to stream flow is obtained from the U.S. Geological Survey water-supply papers, such as No. 992, the 1941 report for the South Atlantic and Eastern Gulf of Mexico basins. This document is of particular importance to the people of Georgia because, for the first time, the state has had a drought and a substantial stream-gaging program in the same year. Stream gaging has been done intermittently in Georgia for 50 years, though after 1923 little was done in that direction until a program was started in 1937 under a cooperative agreement between the United States Geological Survey and the Georgia Department of Mines, Mining, and Geology.

During the period from 1923 to 1937, two major droughts occurred—in 1925 and 1931. The 1925 drought was the worst we have ever had—that is just about all we know about it in terms of engineering facts, as there are no figures the engineer can put on his slide rule, only assumptions or hearsay. No one likes to base calculations on legends, any more than a business man likes to invest his capital on the oldest inhabitant's recollections. And yet, much of our investment in this vital water-supply business was of necessity based on little more than rainfall records and scattered fragments of stream-flow records in the drought year of 1904.

Now, as a result of the present stream-gaging program, the hydraulic engineer in Georgia has something tangible to work with. He can find, for example, that the 1941 drought conditions recur once in ten years or so. He can find that in almost every year the streams of Georgia drop to within two or three times the 1941 minimums, indicating that 1941 may not have been so extraordinary after all. He finds, too, that many of his old estimates based on average rainfall and runoff percentages are subject to gross errors.

There are no possible average coefficients that can be applied to average rainfall data to produce the variations in low-water flow shown in Fig. 1 for the 1941 runoff in Georgia north of the Fall Line. Yet we often read that Georgia has an abundance of water resources because its rainfall averages 50 in. a year. The map (Fig. 1) shows a wide variation in the 1941 runoff—all from areas with practically the same average annual rainfall.

In this the industrial section of Georgia, water for industry must come from rivers. Because most of the towns are not located on large streams and many are on the ridges far from major streams, they are limited in their growth because of water supply. Obviously there is much more water available during most of the time than during this 1941 minimum, but a vital war plant like a powder plant, for example, must have the water without fail. No chances can be taken that a severe drought in one of the war years will curtail production.

The map, Fig. 1, shows some interesting facts—a 12,000-sq mile area in north Georgia has a yield of less than 0.10 cu ft per sec per sq mile and, for 8,000 sq miles, the yield is more than 15 cu ft per sec per sq mile. The "average" yield is 0.15 cu ft per sec per sq mile, but only 20% of the area comes within 40% of this quantity.

At first glance one might jump to the conclusion that half of north Georgia is in a bad way with respect to water. Blind statistics might show that. In the Far West, statistics on rainfall show that crops cannot be grown in certain areas, but engineers have provided water for irrigation in those areas so that the 4% of land that is irrigated produces 11% of the crops.

In general the water supply problem of north Georgia—in peacetime at least—is a simple one for engineers and is not necessarily a job that will call for any great investment. It does, however, call for a better knowledge of water resources—of necessity obtained prior to the need—especially on the small streams in the area, for it is only through gaging-station records and related investigations that the engineer can get facts to work with. Without these facts, economical and wise development is hardly possible. With these facts, the engineer can face any water supply problem with confidence.

In modern civilization the word "drought" has no place. The dictionary defines drought as a protracted dry spell. Actually, we never hear of drought unless there is an unexpected deficiency of water that affects our pocketbooks—that is, a deficiency greater than we were prepared for. Farmers don't talk of drought except in the growing season. The water available in the 1941 drought in Georgia would have looked like a flood in the arid sections of the West. If "drought" is to be used, it ought to apply not to weather—lack of rain—but to people—that is, lack of brains. For we are able, if we choose, to adapt our economy to fit rainfall or water supplies so that extreme variation in the supply will not mean disaster. With the facts already known or readily obtainable, the elimination of the dangers and damages of droughts becomes an engineering and economic problem which to a large degree we will be able to solve.

LIGHT EQUIPMENT, CALLED FLORIDA-TYPE CRANE, USED FOR MEASURING STREAM FLOW FROM BRIDGES

Organizational Set-up of an "Architect-Engineer"

Well-Coordinated Staff Required to Direct War Construction

By Don Hull McCreery, M. Am. Soc. C.E.
Chief Engineer, Leeds, Hill, Barnard and Jewett, Los Angeles, Calif.

For a Large Project, a Field Drafting Room Is Essential

HOW often one hears the complaint from members of an engineering organization, "We could get a lot more done if only we knew what our responsibilities are." This waste of ability and energies can and should be avoided, and Mr. McCreery tells how. For his examples he has drawn upon the set-up established by his firm and adapted to the handling of Architect-Engineer contracts for the design and construction of huge cantonments and other wartime projects. By the proper assignment of duties and responsibilities, the skills of large numbers of technical men have been efficiently coordinated.

WITH the advent of the war construction program in 1940, a new term came into common usage—the "Architect-Engineer." All firms, whether engineers or architects, chosen to design military projects were so designated. It might be inferred from this term that the work to be handled would be as much architecture as engineering. This was undoubtedly true on defense plants, but on cantonments, depots, airfields, and ammunition dumps, it was predominantly engineering.

To meet the demands of this construction program, it was necessary for the organizations chosen as Architect-Engineers to expand rapidly in both size and scope. As business generally was comparatively quiet at that time, and men were plentiful, the problem of expanding the subprofessional personnel was easily solved. The solutions for other problems presented by the change from a peacetime to a wartime basis, however, were not so quickly or so easily found.

On many contracts it was necessary for engineering, or engineering and architectural, firms to combine in order to secure sufficient financial or technical resources. Because all the technical work, whatever its nature and extent, was to be handled under one contract, combinations were also advisable in order to provide the widespread professional skills required.

However, a number of firms chosen as Architect-Engineers on War Department projects at the start of the program were already so organized in peacetime that the new work required only expansion in personnel. This was the case with the firm with which the writer is associated. Since the experience of this firm as Architect-Engineer is believed to be typical, its organizational set-up on projects handled for the War Department will be described.

Each project had its own field office, headed by a resident partner, with complete facilities for handling the accounting as well as all the technical details of that particular project. General financial and administrative work for all projects was done in the home office. The firm's peacetime activities had been so organized that the field offices were quickly and easily established on or near the site of new work, and the change-over to wartime operation was largely a matter of adding manpower. In a limited number of specialties, technical consultants were engaged from time to time as advisers to the design staff.

During the time that war construction work was under the office of the Quartermaster General, and in some cases while it was under the Office of the Chief of Engineers, Architect-Engineer contracts were divided into two parts—known as Title I and Title II. The first covered all the work of investigation, design surveys, site layouts, designs, and preparation of working

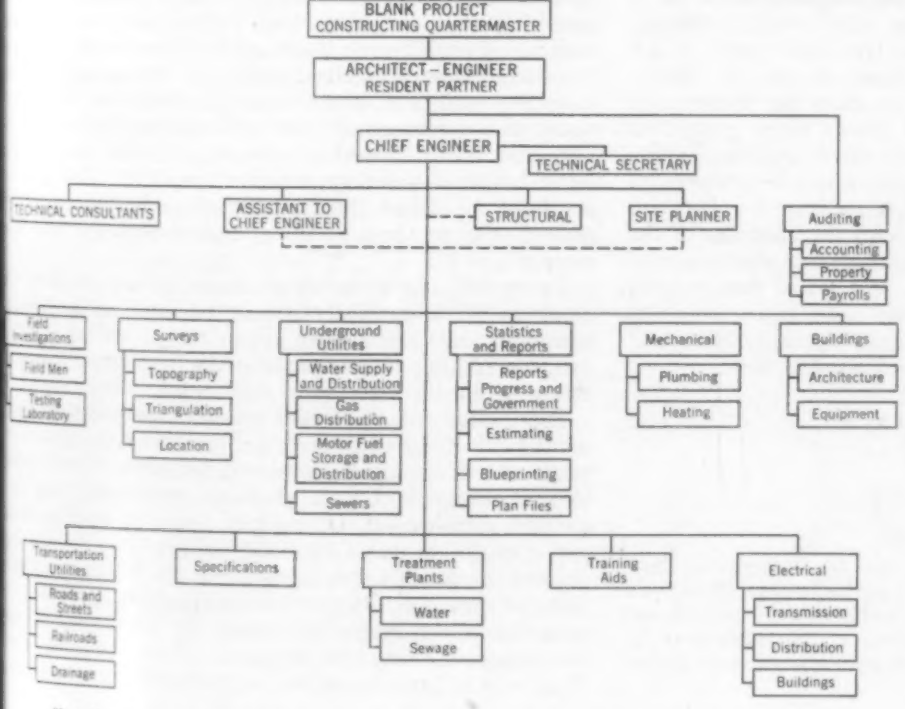


Fig. 1. Organization Chart for a Design Staff on a Cantonment Project

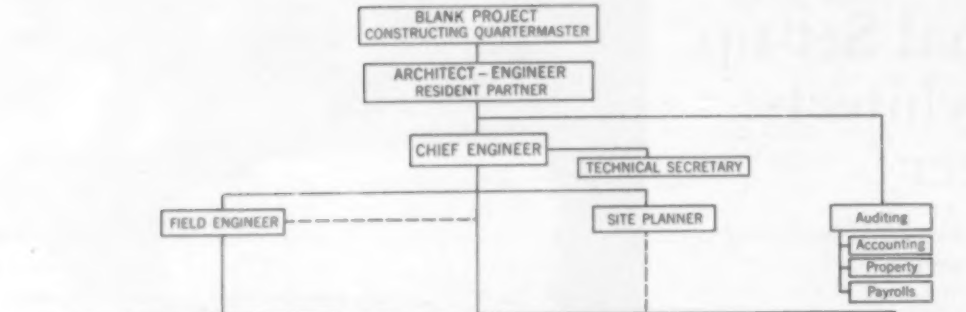


FIG. 2. ORGANIZATION CHART FOR CONSTRUCTION STAFF ON SAME PROJECT AS FOR FIG. 1

drawings and specifications incidental to the planning of the project. The second covered the engineering work in connection with the actual construction, such as inspection, construction surveys, payment estimates, progress reports, and record drawings.

The organization necessary to prosecute the work covered by Title I was made up predominantly of surveyors, designers, and draftsmen. In Fig. 1 is shown this firm's basic organization chart for Title I on a large West Coast cantonment project where the planning and design were completed entirely before the construction began, and where there was therefore no overlapping of functions as regards design and construction. For the construction staff the organization chart differed somewhat (Fig. 2). One of the requirements of a smooth-running organization is that every member know his job and its relation to the other parts of the organization. Therefore the chart shown in Fig. 1 was expanded for each project to show the names and positions of all personnel, and prints were posted in conspicuous places throughout the office. Accompanying the chart, and supplementary to it, was a Departmental Job Analysis. These two documents together outlined clearly the line of authority through the channels of the organization and set up the duties, responsibilities, and limitations of each department. A copy of this analysis was furnished to each department head and it was also made a part of the "Office Design Standards Manual." The first part of this job analysis is quoted here.

DEPARTMENTAL JOB ANALYSIS

FOR THE

BLANK PROJECT

June 24, 1942

This job analysis is complementary to the Organization Chart for the Blank Project; the two together outline the normal administrative and functional responsibilities of the different department heads. It is the purpose of this analysis to set forth the duties, responsibilities, and limitations of each department head in the organization.

It will be noted from the organization chart that all matters pertaining to administration flow through definite channels. Matters other than administrative may be short-circuited to any part of a department as long as the person responsible for that department is informed of such matters without delay. In no case should the flow of administrative or functional matters upward be other than through channels.

It is essential that the flow of business through the organization be governed by the above principles and that the conditions therein be adhered to by all parties in the organization.

There followed a statement of the specific duties and responsibilities of members of the staff. For example:

CHIEF ENGINEER

The Chief Engineer shall be responsible for the administration of all departments of the organization. It shall be his duty to coordinate the activities of all technical departments to the end that these departments shall interact and cooperate smoothly and with the greatest efficiency.

The Chief Engineer is directly responsible to the Resident Partner, and in the absence of the Resident Partner he assumes all of the duties and activities of the Resident Partner.

Since on the Architect-Engineer contracts there was a large volume of correspondence, it was essential to the efficient functioning of the organization to keep this correspondence flowing through the proper channels. There were, therefore, three office bulletins accompanying the Departmental Job Analysis that outlined correspondence procedure and routing. These bulletins were also furnished to each department head and were included in the "Office Design Standards Manual." The first of these bulletins set up three classifications of incoming and outgoing mail, described in detail the routing of each class, designated the parties responsible for each class, prescribed rules for the signing of the outgoing mail, and in addition provided that all department heads concerned with the subject matter of an outgoing letter should be given a chance to read the letter before it was dispatched. The other two bulletins set forth in detail the number of copies of letters required, the method of filing correspondence, and like matters.

To obtain the best results from an organization, its work must be carefully scheduled, and an intelligent, complete, and up-to-date record must be kept of the progress made as compared with the work schedule. For work under Title I this was comparatively simple.

Soon after the start of a project, when each department head had had time to get in mind a picture of the work ahead for his department, he prepared a Departmental Progress Chart showing graphically the important divisions of the work and the expected starting and completion dates for each division. As the starting date of the project was known, and the required completion date was usually given in the contract, each department knew the limits into which its work must fit and the progress that was required. Shown on the same chart was a "growth curve," or percentage-of-completion

curve for the department as a whole. A typical Departmental Progress Chart is shown in Fig. 3.

From the assembled Departmental Progress Charts the Project Progress Chart was prepared. This chart was identical in form to the departmental charts, but showed the progress graphically by departments rather than by divisions of work, with a completion curve for the entire project. In the event of major changes that affected completion dates, the charts were revised to conform to the new conditions. The charts were made on tracing paper for ease of reproduction.

The Departmental Progress Charts were brought up to date every Saturday morning. Each chart was then briefly reviewed by the Chief Engineer with the department head concerned, and immediately after these conferences the Project Chart was brought up to date. The complete set of charts was then sent to the blueprinter, and as soon as the prints were run off, each department head received a print of his department's chart and the Project Chart. At the same time a complete set of prints was handed to the Resident Partner, and another set was mailed to the home office. Prints of the Project Chart were dispatched to all interested parties, and one was posted on the office bulletin board. Thus by Saturday noon everyone in the job office knew the status of the work. Formal periodic reports were furnished the War Department offices, based on the Progress Charts.

In the interval between the construction of the work under Title I and the start of actual construction, the organization underwent a transition from the straight design set-up to the construction supervision set-up necessary under Title II of the Architect-Engineer contract. The basic organization chart for the work under Title II on the cantonment previously mentioned is shown in Fig. 2. This chart was also expanded to show all personnel, and the Departmental Job Analysis was revised to fit the new organization.

When construction started, the work of making reports increased. Not only were detailed construction progress reports required, but semi-monthly payment estimates, change orders, and progress photographs were needed to keep all interested parties informed of the progress made. The preparation of these reports, being a part of the work under Title II of an Architect-Engineer contract, served well to keep the engineering organization familiar with all the work under way. For efficient functioning of the Architect-Engineer forces, it was necessary that all departments be kept informed of field operations, and the different reports required were excellent means of getting this information to department heads.

For the smooth operation of the project as a whole, it was essential that there be close cooperation between the contractor's organization and the Architect-Engineer forces. Day-to-day cooperation on details was handled by the Field Engineer and his Inspection Supervisors, but for job-wide cooperation it was necessary that the executives of the two organizations and the project representative of the War Department get together periodically to discuss accomplished and expected progress. The progress reports prepared by the Architect-Engineer's office formed the basis of these discussions.

Also, it was necessary for the Architect-Engineer to have some voice in the control of field operations if the job was to progress as planned and on schedule. The reports just mentioned, together with the inspectors' daily narrative reports to the Field Engineer, were the means by which the Architect-Engineer organization kept its "finger on the pulse" of the job—a requirement for proper control.

Photographs were used to amplify the progress reports, to quickly inform interested parties removed from the scene of action how the work was being done, and to help them visualize the speed of construction. Two different types of such photographs were taken, and these together gave a very complete picture of the construction. Those of the first type were air views made by an Observation Squadron of the Air Corps and furnished to the project. These were taken on the same day of each week, at close to the same time of day, and as nearly as possible from the same position. The other progress photographs were of detailed operations taken daily by the project photographer, a member of the Architect-Engineer's staff. On one cantonment there was in addition a complete story of the construction from ground breaking to flag raising at completion, taken in 16-mm colored motion pictures. This pictorial record contained many features of general interest, air views and close-up action shots of construction methods. Panoramic views taken from fixed points at regular intervals also gave a good idea of the growth of the camp. All these photographs, incorporated in the project Completion Report, comprised an excellent historical record of the job.

Does this attention to detail in organization pay? Does it enable the organization to produce the desired results? The answers are to be found in the record of achievements. One example will suffice to illustrate the point. On the cantonment previously referred to, the Architect-Engineer contract called for plans and specifications to be ready for delivery to bidders 90 days from the signing of the contract. The specifications were ready on schedule, and that they were clear and complete can be seen from the bids received. The low bid was $17,382,820.71; the second bid, $17,411,148.87; and the Architect-Engineer's estimate, $17,202,312.71. And all three were $3,500,000 less than the War Department had expected to pay for the job!

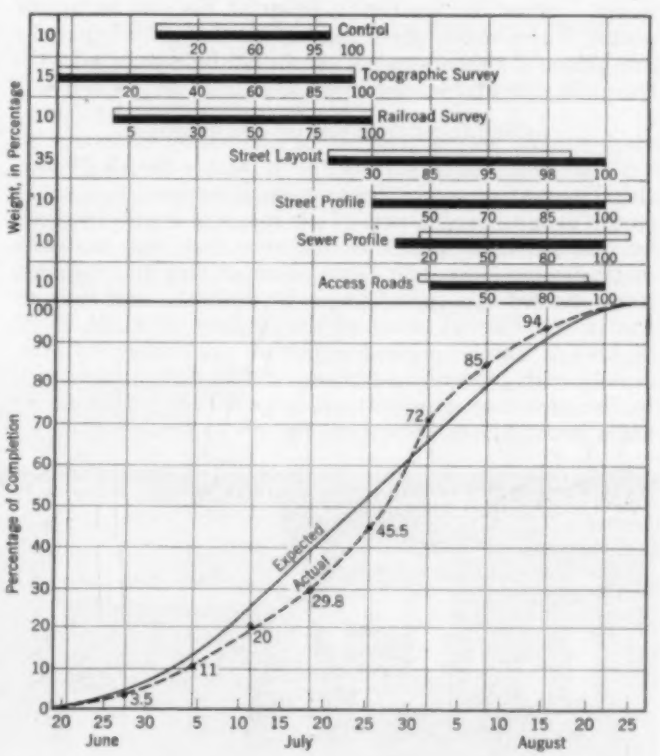


FIG. 3. DEPARTMENTAL CHART FOR DESIGN PROGRESS—BROUGHT UP TO DATE EACH WEEK

Removal of Air from Pipe Lines by Flowing Water

By A. A. KALINSKE *and* PERCY H. BLISS, ASSOCIATE MEMBERS AM. SOC. C.E.

ASSOCIATE DIRECTOR AND FORMER RESEARCH FELLOW, RESPECTIVELY, IOWA INSTITUTE OF HYDRAULIC RESEARCH, IOWA CITY, IOWA

ACCUMULATION and presence of air at pipe-line summits interferes with the carrying capacity of the pipe. To investigate the removal of this air by flowing water a project was initiated at the Iowa Institute of Hydraulic Research under sponsorship of the J. Waldo Smith Fellowship Committee of the Society. Professor Kalinske and Mr. Bliss here report the results of the second year of that study for the benefit of engineers.

A PROBLEM of considerable importance to water-supply engineers and others concerned with proper operation of pipe lines is presented by the accumulation and presence of air at pipe-line summits. Good practice has dictated that special air valves be installed at high points along any line, and in all probability such valves have been installed many times when they were not actually needed. Besides adding appreciably to the initial cost of any project, these valves require periodic maintenance. It would therefore be of considerable advantage if, where at all possible, the pipe-line designer could regulate hydraulic conditions so that the flowing water would remove the air pockets from the summits. This is especially important in cases where a pipe line may be operating at subatmospheric pressure.

When an air pocket is formed at the summit of a pipe line or beyond a partly open gate valve, the conduit flows only partly full, and at the end of the pocket a hydraulic jump usually occurs. The air may be removed, of course, by use of an air valve; but this is not feasible if the pipe line is under subatmospheric pressure. In any case, it is of interest to know under what conditions an air valve may be necessary or, if an air valve cannot be or is not used, whether the air can be removed by the flowing water. Since the hydraulic jump at the end of an air pocket is a common phenomenon, it was decided that the first phase of this investigation should be concerned with the ability of a hydraulic jump to entrain air.

GENERAL MECHANISM OF AIR REMOVAL

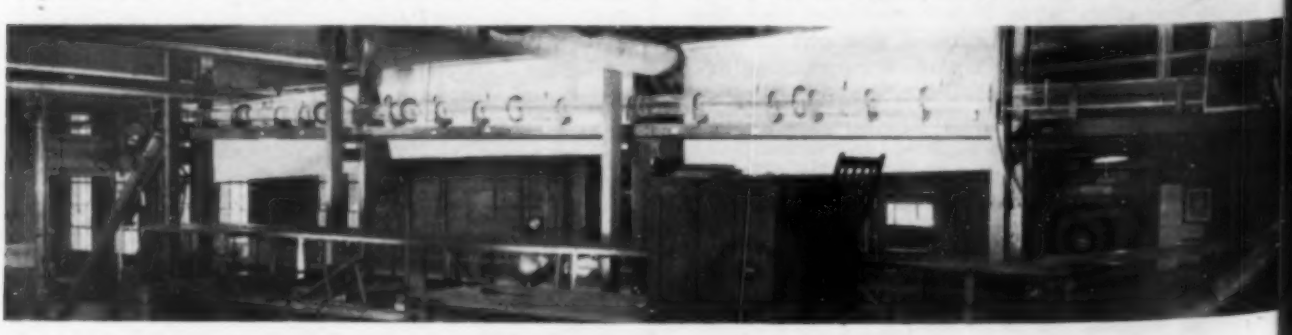
Under the sponsorship of the J. Waldo Smith Fellowship Committee of the Society, an investigation relating to the general mechanism of air removal from pipe lines by flowing water was undertaken at the Iowa Institute of Hydraulic Research. One phase of this investigation was reported in a recent paper by Kalinske and Robertson in the PROCEEDINGS of the Society (Vol. 68, 1942, p. 1141). In the present paper we are concerned principally with presenting certain information of direct use to the pipe-line designer; and specifically, with giving experimental data indicating the water discharge necessary to maintain air removal from any given size of pipe laid at any slope.

The experimental work was performed by the use of 4-in. and 6-in. transparent (lucite) pipes. The pipe line was set up so the line went up to a summit and then sloped down from there, terminating in a tank open to the atmosphere to allow free escape of any air carried down by the flowing water. Both water flow and pipe slope could be varied at will. A general view of the test equipment is shown in the accompanying photographs.

As the water started to flow over the summit and down the pipe, the lower end of the line soon filled, thus trapping a large pocket of air. For all except the very flat slopes, the water flowing down the sloping pipe in the air pocket terminated in a hydraulic jump. The downstream depth of the jump was usually large enough to fill the conduit, although in some cases for low flows at flat slopes the jump did not fill the pipe. In such cases the depth beyond the jump increased gradually until the pipe flowed full. Under such conditions the air-removal phenomenon was considerably different from the case where the jump did fill the pipe, as will be pointed out later.

The agitation present in the hydraulic jump caused the water to entrain air and mix it with the flowing water. It was apparent at the start of the investigations that the air-entraining characteristics of the hydraulic jump in a closed conduit constituted an important factor in the entire problem, so the phenomenon was studied in detail. The PROCEEDINGS paper previously mentioned discusses this factor at length.

From a practical standpoint, however, the rate at which the jump entrained the air did not necessarily correspond to the rate at which air was removed from the pocket. Beyond the jump, except for the air bubbles, the pipe flowed full, and the rate at which the air was eventually removed from the pipe depended on the ability of the water flowing in the pipe beyond the jump to carry the air bubbles along. Except for the higher water flows, the jump pumped air into the water at a higher rate than the flow beyond the jump could handle. The excess air then blew back periodically through the jump. For any



INSTALLATION OF TRANSPARENT PIPE FOR AIR-REMOVAL TESTS

pipe size and slope, there was one discharge at which the rate of air entrainment by the jump was equal to the rate at which air was carried down by the water flow beyond the jump. Below this discharge the air removed depended on the ability of the water beyond the jump in the filled conduit to carry air along; above this discharge the water velocity beyond the jump was sufficient to move all the air entrained by the jump. It should be noted that the hydraulic jump makes available to the flowing water the air which is carried out of the pipe by the water.

A detailed study was made of the rate of air removal for 4 and 6-in. pipes laid at slopes up to 30°, and an attempt was made to generalize the information obtained. Analyses indicated that the ratio of the volumetric rate of air removal, Q_a, to water discharge Q_w—that is, Q_a/Q_w—should be related to the pipe slope, S, and a dimensionless quantity defined as Q_w^2/gD^5, where D is the pipe diameter. The plotting of the data in terms of the foregoing quantities indicated the existence of such a general relationship, the value of Q_a/Q_w increasing with Q_w^2/gD^5 for any slope. The ratio of Q_a/Q_w depended, for any slope, on the value of Q_w^2/gD^5 until a certain value of this quantity was reached, and then it was apparent that Q_a/Q_w became dependent on the Froude number. This number was defined as V_1^2/gh_1, where V_1 is the velocity approaching the jump and h_1 the mean effective depth (water area divided by surface width).

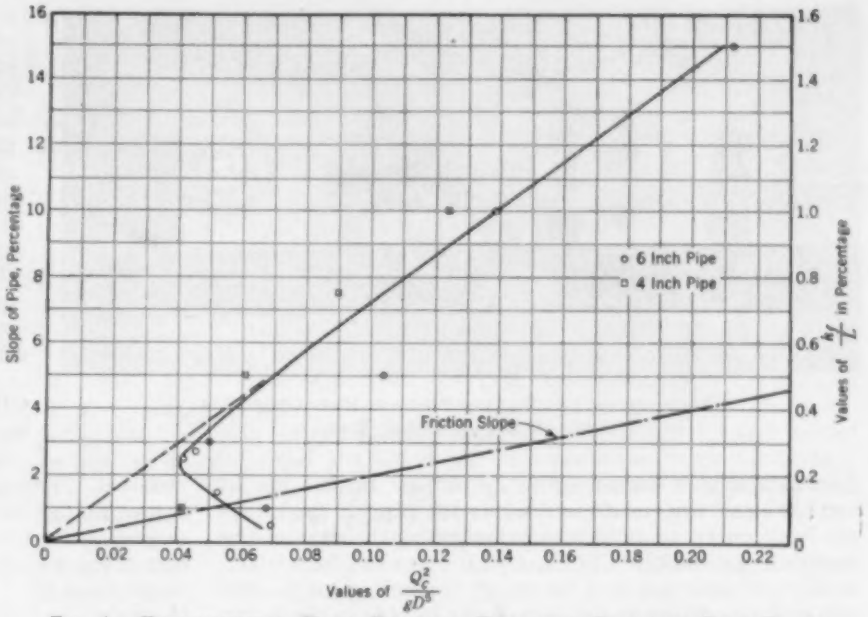


FIG. 1. EXPERIMENTAL DATA SHOWING RELATION BETWEEN PIPE SLOPE, PIPE DIAMETER, WATER DISCHARGE, AND HYDRAULIC GRADIENT WHEN AIR REMOVAL STARTS

The data on rate of air removal, though perhaps not of great direct practical importance, definitely verified the observation that the removal of the air was really controlled by two different hydraulic phenomena. For lower discharges the air removal was controlled by the flow characteristics beyond the jump, which are described by the value of Q_w^2/gD^5. At higher discharges the air removal was controlled by the hydraulic jump, since the water flow beyond the jump was capable of carrying all the air entrained by the jump, and more if it were available. When this occurred, it was found that Q_a/Q_w became a function of the Froude number of the approaching flow, since this number characterizes the ability of a jump to entrain air.

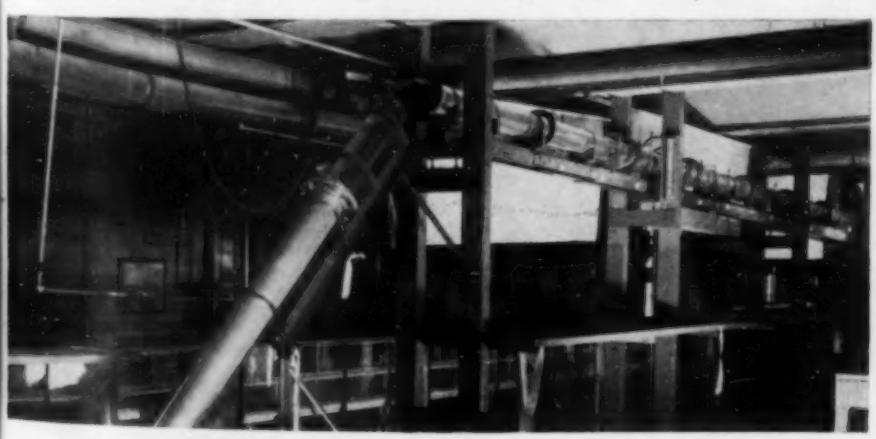
The pocket of trapped air extended from the pipe summit to the hydraulic jump. As the air was removed the jump gradually moved upstream. The rate of movement of the jump was used in calculating the volumetric rate at which air was being pumped out of the pocket. For the smaller slopes it was found, at times, that the entire air pocket would be swept out of the pipe very quickly. However, this could always be prevented by having a slight projection or rough protuberance near the pipe-line summit, to which the upper end of the air pocket would cling. It was felt that in practical pipe-line installations there would always be sufficient surface roughness, particularly at joints, to cause the upper end of the air pocket to remain in position.

MINIMUM WATER DISCHARGE FOR AIR REMOVAL

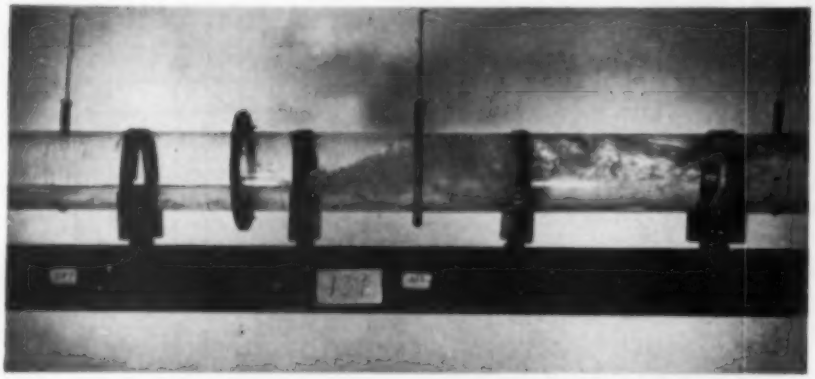
Of considerable practical importance is the ability to determine, for any given pipe size, whether air will be removed from a pocket for a given water flow. For the 4 and 6-in. pipes laid at various slopes, the minimum discharge necessary to start air moving down the pipe was experimentally determined. The controlling factor was, of course, the velocity of water flow in the filled pipe beyond the jump. Below this limiting water flow, even though the jump entrained considerable air, none would move down the pipe; instead, all the air bubbles would blow back through the jump.

It was noted that the smaller air bubbles could be moved more easily than the larger ones. However, the smaller ones would gradually coalesce into large bubbles, which could not be moved, and these would travel up the pipe and pass back through the jump. Though the exact limiting water discharge was difficult to determine, measurements sufficiently accurate for practical use were obtained.

For purposes of correlating the data, an analysis was made of the physical conditions at this limiting flow. At this limiting or critical condition we can consider



FITTINGS AND SUPPORTS FOR PIPE LINE WERE ADJUSTABLE TO TEST CONDITIONS



HYDRAULIC JUMP FILLING PIPE AND ENTRAINING AIR
Pipe Was Laid at 5% Slope

that two sets of forces acting on an air bubble are in equilibrium; the component along the pipe of the buoyant force on an air bubble is balanced by the drag of the water on the bubble. The buoyant force can be written as $kL^3\rho gS$, where k is a constant depending on bubble shape, L is a linear dimension of the bubble, ρ the water density (the air density is neglected, since it is small compared to that of the water), g the acceleration of gravity, and S the pipe slope—or more exactly sin θ, where θ is the angle the pipe makes with the horizontal. The drag of the water on the bubble can be represented by $CL^2\ \rho v_c^2$, where C is a drag coefficient, and v_c the effective water velocity acting on the bubble when this bubble is in equilibrium. This is the common expression for fluid drag on any object. For this critical condition we thus have:

$$kL^3\ \rho g^S = CL^2\ \rho v_c^2 \quad \ldots\ldots\ldots\ldots (1)$$

or transposing,

$$\frac{v_c^2}{gL} = \frac{kS}{C} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Note that for any given value of S, v_c becomes less for the smaller bubbles. The drag coefficient, C, will depend on the Reynolds number for the bubble and on its shape. In general, v_c will be related to the mean pipe velocity, V_c and L/D.

Nothing further can be gained from this analysis, unless some assumption is made regarding the value of L, the linear bubble dimension. The simplest assumption is that L depends on the pipe diameter; then the ratio L/D becomes a constant. Consequently in Eq. 2, L can be replaced by D and v_c by V_c and we have:

$$\frac{V_c^2}{gD} = \frac{k_1 S}{C} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Or replacing the mean velocity, V_c, by the water discharge, Q_c, there is obtained:

$$\frac{Q_c^2}{gD^5} = \frac{k_2 S}{C} \quad \ldots\ldots\ldots\ldots (4)$$

Equation 4 indicated a linear relationship (assuming C substantially constant), between the dimensionless quantity Q_c^2/gD^5 and the slope, S. Of course, this may not be quite true, and the function relating these two quantities may be other than linear. In any case, we can now plot our experimental data in terms of these quantities.

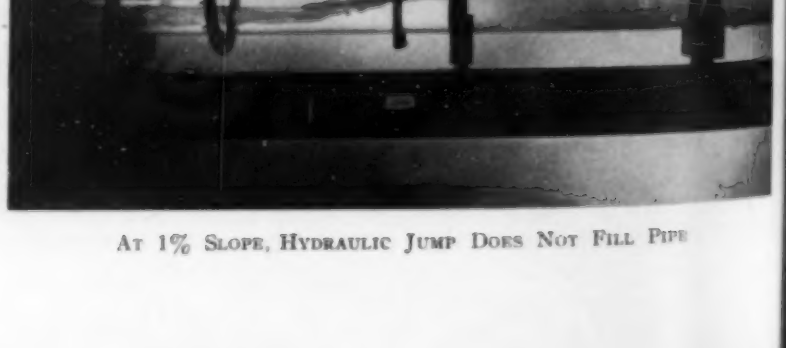
In Fig. 1 is shown a plotting of the experimental data obtained in the 4 and 6-in. pipes, and though there is considerable scatter, a general functional relationship is indicated. Note that for higher values of the pipe slope, S, the data scatter about a straight line passing through the origin, thus confirming Eq. 4. The peculiar deviation of the data for the smaller slopes is quite interesting. This deviation occurred when the hydraulic jump at the lower end of the air pocket did not fill the pipe, and thus the process of entraining the air was quite different from that when the downstream depth of the jump was greater than the pipe diameter.

It is apparent that for slopes less than $2^1/_2\%$, for any given pipe size, higher water discharges will be required than are required at a $2^1/_2\%$ slope to initiate air removal. This appears to be a very significant item since it means that no advantage is gained by using very flat slopes. Of course, to maintain proper air removal the actual value of the water discharge should be appreciably larger than Q_c. In using Fig. 1 for any practical problem, the value of Q_c should not be taken equal to the water discharge when the pipe flows completely full. Rather it should be a value of discharge somewhat less than that, since when air pockets form in a pipe line the flow for any given pressure drop will be appreciably less than that expected. Also plotted on Fig. 1 is the value of h_f/L, the friction slope when the pipe flows full. Using the ordinary pipe-friction formula, the equation of this line is

$$h_f/L = \frac{8f}{\pi^2}\frac{Q_c^2}{gD^5} \quad \ldots\ldots\ldots\ldots\ldots (5)$$

The straight line plotted is for $f = 0.025$, which is a good average value for this friction factor for our smooth test pipes. It should be noted that this friction slope is considerably less than the pipe slope; in fact the ratio is about 1 to 35 for the experimental data at pipe slopes greater than $2^1/_2\%$. In other words, to start air bubble movement down a sloping pipe, the water flow need be such that the hydraulic gradient is very much less than the pipe slope. It is believed that the data in Fig. 1 will give some indication of the conditions to be met if air removal by flowing water is to be obtained in pipe lines.

The authors wish to thank Dean F. M. Dawson, of the College of Engineering at the University of Iowa, for his interest and suggestions during the course of the studies. We appreciate the opportunity that was given us by the J. Waldo Smith Fellowship Committee to carry on this investigation, and the very helpful advice contributed by Karl R. Kennison, chairman of the Committee, who reviewed the detailed report on which this paper is based.



AT 1% SLOPE, HYDRAULIC JUMP DOES NOT FILL PIPE

Engineering in a Department Store

By J. C. PRATHER, ASSOC. M. AM. SOC. C.E.
GENERAL SUPERINTENDENT, RICH'S INC., ATLANTA, GA.

CIVIL Engineers are adaptable people. Strange as it may seem, they have even invaded the department store field. How their ability and ingenuity are put to use most practically, in planning, in sales, and in distribution, is demonstrated here by Mr. Prather, who speaks from experience with a store having 2,000 employees. His paper was originally presented before the Georgia Local Section.

WHAT place of usefulness can a civil engineer find in a large department store? After eight years of experience, I know there is plenty of activity that can be classified as engineering—civil, or any other kind.

Any business, large or small, involves engineering—divided into design, research, construction, operation, management, training, and standardization. In a department store the planning of the building itself is probably the simplest design problem. The real designing comes when the building is finished and the engineer has to lay out the interior space into departments. Research then begins; no books give an answer that will fit any two towns or any two stores in the same town. Why, it may well be asked, is this so? In the first place, merchandise that is essential in one locality is a luxury in another; this affects the layout of each department, and even determines the floor it has to be put on. Patrons have characteristics that fix the location, after the management has decided the class or classes of trade to which it proposes to cater.

SOLVING DISPLAY PROBLEMS

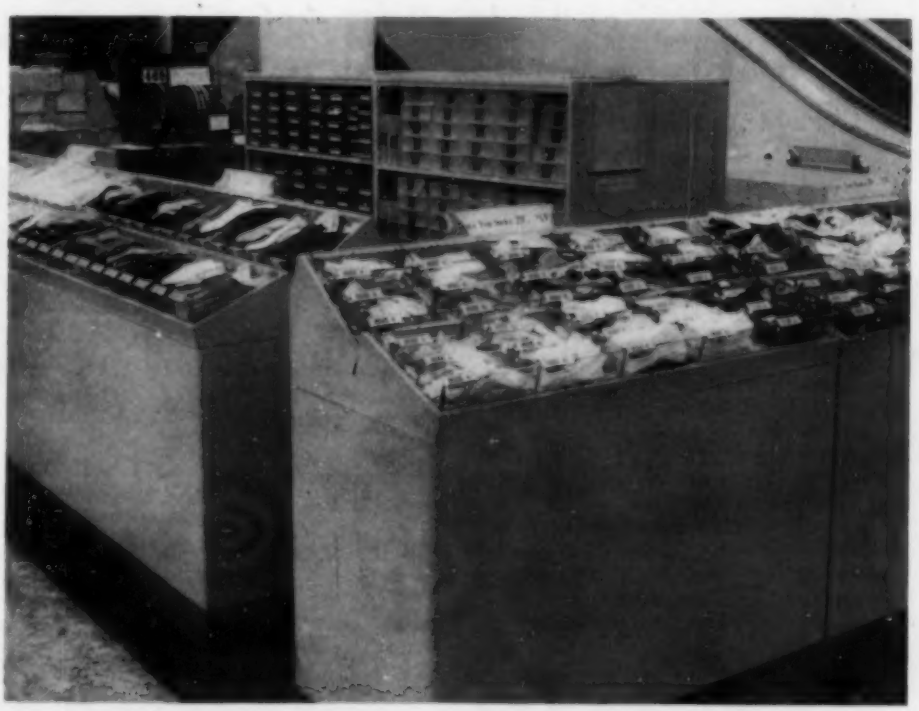
Once the department layouts by floors are fixed, we have what looks like a series of state maps with the county boundaries and county names, but no towns, streams, or roads shown. The research begins all over again—this time to determine how much and what merchandise is to be sold in each department, then to design the proper fixtures to hold it. Right here the method of selling becomes paramount, whether by customer self-service, where she waits on herself; display selling, where she decides from merchandise displayed, and with the help of a sales person; or lastly, by de luxe selling, in which the sales person in private or semi-private rooms shows the customer only what she wants her to buy.

Up to this point we have laid out a floor with fixtures all prepared for selling to the customer, but selling is only the second of three processes in a department store, although it is all the average layman ever hears about. The first is getting the merchandise into the store, and ready to sell. The third consists of getting the merchandise to the customer in good shape, at home or at the store. Actually the sale of goods to the customer occupies only a third of the personnel.

So research begins again, this time we decide (Fig. 1) how we are to receive the goods and where, where and how we will open, check, and price them, where and how we will stock them, and in what relation, that is, how much goes to the selling floor, how much in the stock room, and how much in a warehouse. Several questions enter in, such as how near the market is the store; what is the delivery time; whether the stock is staple, seasonal, luxury, fad, or promotional; and who has to get it and when? Once these matters are fixed, we set up our services for incoming goods.

We then investigate all the details of selling, comfort of patrons, display of goods, advertising, and welfare of the staff. With all these in mind we can complete the layout of the store in a logical and coherent manner.

In the original basic design of the building, many things are fundamental, for example: What the store's face should look like; how to plan for entrance and exit of customers and employees; whether they are to be hot or cool in the summer; to walk up stairs or ride in elevators and on escalators; to drink free ice water or buy cold drinks; to use our restrooms, showers, and hospital; to have clean air to breathe; to be able to see outdoors, to tread on wood, concrete, terrazzo or carpeted floors. Do we want them to be in a fireproofed building, to look at ugly beams, to see all goods well? Future extensions and improvements to the building must be thought of as the design progresses or such extensions will cost double because of lack of foresight.



DISPLAY COUNTER FOR SELF-SELECTION
Height and Angle of Inclination Designed for Convenience of Customers and to Promote Sales

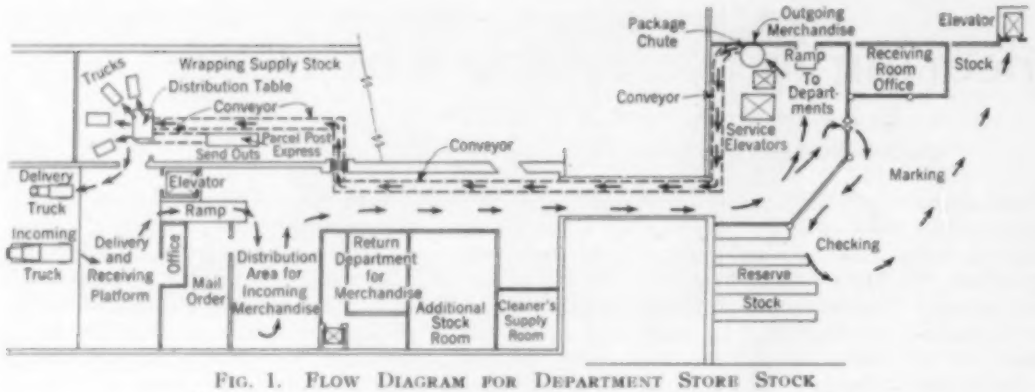


FIG. 1. FLOW DIAGRAM FOR DEPARTMENT STORE STOCK
This Compares with Materials Movement on a Construction Job

Construction begins. Here the engneer has the inspection job for the building and its mechanical features. Once the building is complete, painting is started in consultation with the architect and color experts; floor coverings are placed; and work starts on installing fixtures. The store is then ready for merchandise. Newspaper and engraved invitations inform the public of the big opening. We meet customers at all entrances with waving flags, doormen, and souvenirs. All this has been coordinated by the promotion manager and the engineer, the physical arrangements having been carried out by the engineer.

THE ENGINEER'S ROLE IN OPERATION AND MAINTENANCE

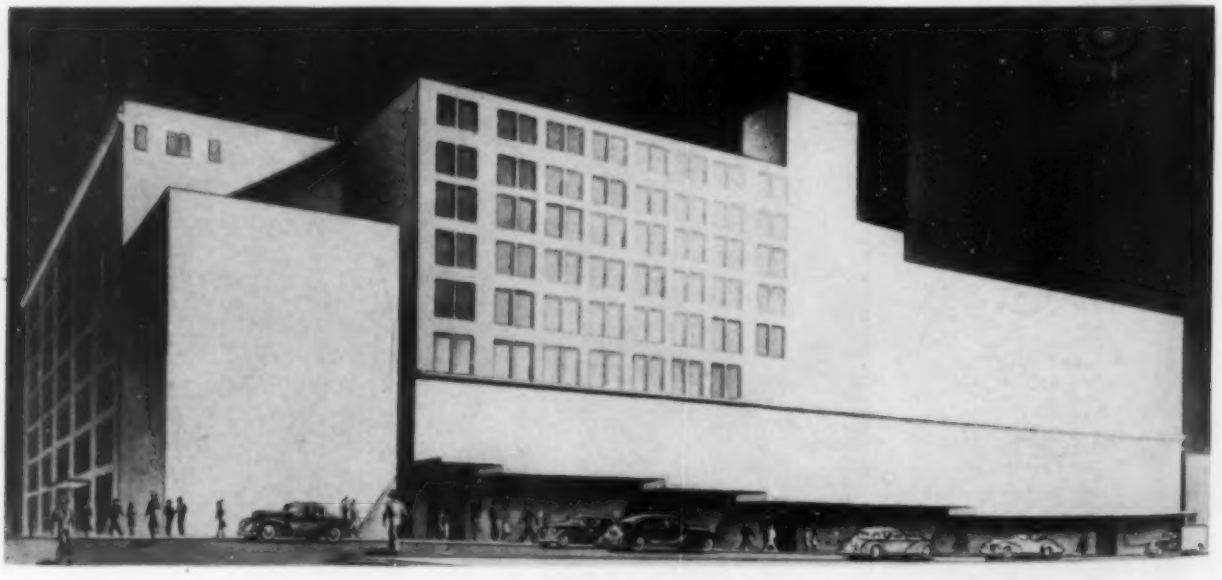
A regular routine of business then develops. It is far from humdrum, as no day is like the one before. This is a full-time job for the engineer. He must operate the building so that the people in it are comfortable the year round, whether there is a large crowd or only a few people in the store. He must keep his vertical transportation efficient, allowing no shutdowns during store hours. He must see that plenty of hot and cold water is always available; that every part of the building is safe to the *n*th degree; that there is plenty of light; that the store is always kept clean; that porter service is available; that there are proper telephone facilities for all alike; and finally that there is a pneumatic-tube system operating 100% for all departments.

Of course, there are many mechanical appliances that must be kept going. Thus the operating end of the business is quite a job for the engineer without considering the moving of materials and supplies in and out of the building. He has to set up standards and to train his staff for efficient operation and maintenance.

From all this it is obvious that the engineer must have considerable part in the management of the store, to see that all phases function smoothly and in complete harmony, that changes are made in order to facilitate business gains, and prevent losses. Good management is just as interested in civic problems as in whether the store makes a profit, because anything that is for the betterment of the community must naturally benefit the store in the long run. It has been well said that the department store is a dual business—merchandise and real estate. The merchant is usually one of the biggest taxpayers in the city.

Whenever the management makes a decision to move or change a department, the engineer starts from scratch, designing, doing research, constructing, operating and training, exactly as he would if a new store were being built. And good management makes many such decisions during the year owing to the nature of the retail business. Twice a year, at Christmas and Easter, the department store hits its peak in business, and it is up to the engineer manager to foresee and prepare for this strain on his force and equipment, which was designed not for a peak but for average use.

With this brief picture in mind, an engineer reader will better appreciate the workings of a department store. The next time he walks through one he will be surprised at what he sees out on the surface, and if he can get behind the scenes and visit the real works, he will be even more surprised.



STORE DEVELOPMENT—ARTIST'S VIEW SHOWS OLD PART OF BUILDING WITH NEW (WINDOWLESS) PART

Manpower in Construction

Part I. Job Costs Cut by Labor Management

By L. E. Brigham, M. Am. Soc. C.E.

Labor Relations Officer, Construction Division; Office, Chief of Engineers, War Department, Washington, D.C.

TO operate efficiently, a "cat" must be greased, fueled, and properly maintained, but above all it must have a lot of work to do and plenty of room in which to do it. If a workman is to do his job well he must be given similar consideration. Labor is the greatest cost on many jobs, not because of high wages but because it is not used effectively. It is possible, as Mr. Brigham shows, to plan work so that each workman is properly selected, supplied with materials as needed, given a challenging job to do and the incentive to do it with dispatch.

IT is often true that what is in the interest of everyone is the accepted responsibility of no one. Whether or not a craftsman renders a full day's production for a full day's pay is of vital importance to the craftsman in that it affects his morale and his ability to continue to earn a living. The supervisor of the craftsman is concerned because it is his responsibility to get the work done. The employer is interested because he must stay within the appropriation for the construction. And, in the last analysis we are all affected because, be it a public works project or a private enterprise, we pay the bill.

Fortunately, the engineer on construction is in a position to encourage or require good labor management. Most engineers are keenly aware of the labor factor, but to them it seems something apart from their normal responsibilities in engineering design, control, and inspection of the materiel of construction. In order to achieve the over-all economy inherent in good engineering design, it is the engineer's responsibility to have full knowledge of the labor factors affecting his project. In his use of practically every item, large or small, which goes into construction, the engineer is guided by detailed contract specifications except for labor, which is half of the total cost. Before answering the question, "How may high labor costs be corrected?" it is best to examine some of the elements of these costs, and their magnitude, from a local and national viewpoint.

LABOR COSTS

Better than half of the wartime construction costs may ordinarily be charged to labor, although the exact percentage varies with the type and location of the project. Labor rate structures vary in each locality and are dependent upon cost of living, supply and demand, and union organization. A study of the wage structure in Washington, D.C. (Fig. 1), while higher than average, should be at least indicative of prevailing conditions. The minimum wages to be paid on public works are determined by the Department of Labor under the Davis-Bacon Act. This determination is an important element in the labor picture as it sets the money value in rates to be paid for each mechanic or labor classification.

Most construction jobs have operated on a 48-hour to 56-hour basis during the war program. Through a recent Executive Order, some public jobs were put on a 48-hour basis, which had previously been on 40 hours. Under the Stabilization Agreement, mechanics, laborers, and trade foremen must receive time-and-a-half for work performed on Saturdays, Sundays, and holidays. They also receive the same overtime rate for work over 8 hours per day.

It will be noted in Fig. 1 that the hourly rate for certain typical classifications is listed in each wage range. In order to give a ready basis for comparison, the annual wage rate is shown in chart form. As indicated by this chart, the common laborer works for $87\frac{1}{2}$ cents an hour, and makes $7.00 on week days, and $10.50 on Saturdays, Sundays, and holidays. His annual rate is $2,366. Again glancing at the chart, it will be seen that the highest rate is that listed for the electrician, with a rate per hour of $2, week-day pay of $16, and Saturday, Sunday and holiday pay of $24; rate, $5,408 a year.

Foremen of course receive a higher wage than the ordinary workman, as shown in Tables I and II. A labor foreman, for instance, makes $8 a day, $12 on Saturday, and works at the rate of $2,704 a year. Electrician foremen get $18 on week days, $27 on Saturday; rate, $6,084 a year. On the other hand an apprentice (see Table III) in the carpenter trade during his eighth 6 months makes 83% of the journeyman's rate, which totals $10.79 week days, $16.18 Saturdays and holidays; rate, $3,646.76 a year. The apprentice is normally a young man, averaging from 20 to 24 years old, with an eighth-grade to high-school education, and he usually has very little responsibility.

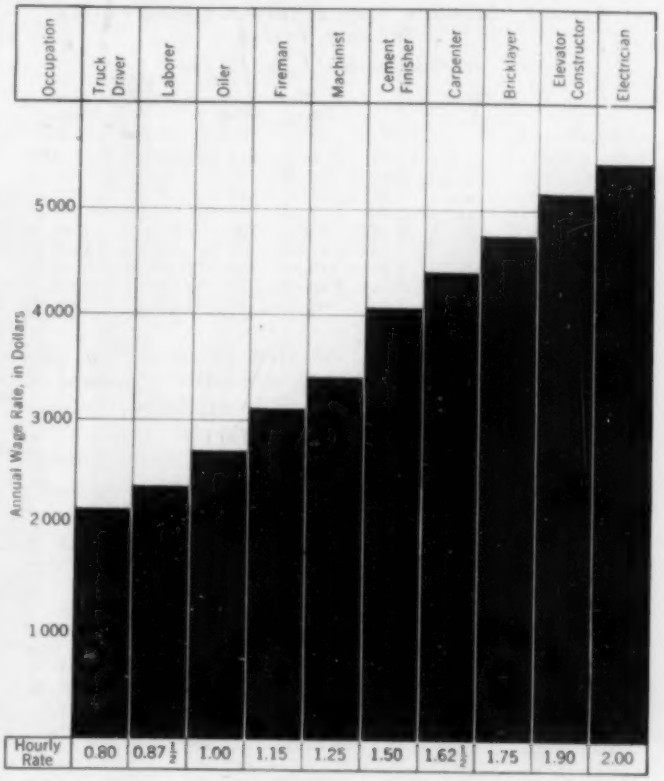


FIG. 1. MINIMUM WAGE RATES FOR WORKMEN, WASHINGTON, D.C., MAY 1943
Annual Wage Assumes a 48-Hour Week

The preponderance of ordinary trade classifications in the high wage rate group is shown in Fig. 2, in which 45 are listed above $1.50 an hour, and only 18 below. This overweight in the higher wage range is one basic cause for high labor costs. Of the 45 classifications listed above $1.50 an hour, it will be noted that 11 are in the $2.00 an hour bracket, 12 at $1.75 an hour, and 11 at $1.50 an hour. In the location and design stages of a project, the engineer should carefully consider the wage-rate structure applying, in order to estimate labor costs and control design where possible so as to minimize the use of critical and high-cost labor classifications.

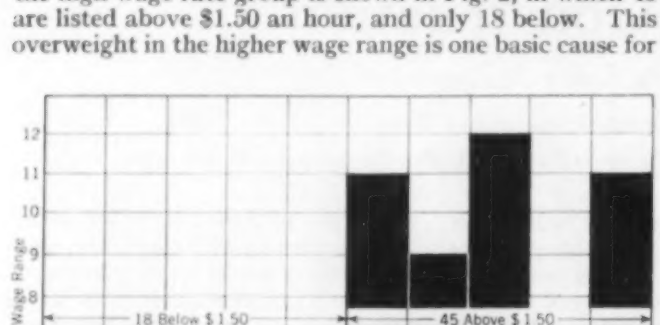


FIG. 2. BASED ON WAGE RATES SHOWN IN FIG. 1, 70% OF TRADES ARE IN WAGE RANGE OVER $1.50 PER HOUR

Volume of labor cost in government construction, in dollars and employment, over the past three years, with an estimate for 1943–1944, is shown in Fig. 3. This illustrates the extreme importance and approximate magnitude of the labor factor in construction. It will be noted that during 1942–1943, somewhat over three billion dollars was expended for labor, and approximately one million workmen were steadily employed. An analysis of the situation shows that expenditures during 1943–1944 will approximate $1,800,000,000 with an average employment of about 600,000, on the basis of a 300-day year.

It should be emphasized that the wage rate paid is not the most important element in the total labor cost. The "unit cost" is the measure of labor production. The best over-all economy may be attained through paying a wage that will attract competent labor, continuously checking to see that only competent labor is employed, and systematically following through to insure the highest production.

TABLE I. MINIMUM WAGE RATES FOR FOREMEN IN KEY BUILDING TRADES

Washington, D.C., May 26, 1943

CLASSIFICATION	HOURLY	WK. DAY (8 hr.)	SAT. (8 hr.)	PER WK. (48 hr.)	PER YEAR (52 wks.)
Labor fore.	$1.00	$ 8.00	$12.00	$52.00	$2,704.00
Bricklayer fore.	1.87½	15.00	22.50	97.50	5,070.00
Carpenter fore.	1.87½	15.00	22.50	97.50	5,070.00
Electric. fore.	2.25	18.00	27.00	117.00	6,084.00
Painter fore.	2.14½	17.14	25.71	111.41	5,793.32
Plasterer fore.	2.12½	17.00	25.50	110.50	5,746.00
Plumber fore.	1.87½	15.00	22.50	97.50	5,070.00
Sheet-metal fore.	2.00	16.00	24.00	104.00	5,408.00
Struct.-iron fore.	2.35	18.80	28.80	122.20	6,354.40

TABLE II. MINIMUM WAGE RATES FOR WORKMEN IN KEY BUILDING TRADES

Washington. D.C., May 26, 1933

CLASSIFICATION	HOURLY	WK. DAY (8 hr.)	SAT. (8 hr.)	PER WK. (48 hr.)	PER YEAR (52 wks.)
Laborer	$0.87½	$ 7.00	$10.50	$ 45.50	$2,366.00
Bricklayer	1.75	14.00	21.00	91.00	4,732.00
Carpenter	1.62½	13.00	19.50	84.50	4,394.00
Electrician	2.00	16.00	24.00	104.00	5,408.00
Painter	1.71½	13.71	20.56	89.11	4,633.72
Plasterer	2.00	16.00	24.00	104.00	5,408.00
Plumber and Steam fitter	1.75	14.00	21.00	91.00	4,732.00
Sheet-metal worker	1.75	14.00	21.00	91.00	4,732.00
Struct.-iron worker	2.00	16.00	24.00	104.00	5,408.00

TABLE III. MINIMUM WAGE RATES FOR APPRENTICES IN KEY BUILDING TRADES

Washington, D.C., May 26, 1943

CLASSIFICATION	HOURLY	WK. DAY (8 hr.)	SAT. (8 hr.)	PER WK. (48 hr.)	PER YEAR (52 wks.)
Bricklayer app. (4th year)	0.55	$4.40	$6.60	$28.60	$1,487.20
Carpenter app. (8th 6 mo.)	1.35	10.79	16.18	70.13	3,646.76
Electrician app. (4th year)	1.25	10.00	15.00	65.00	3,380.00
Painter app. (4th year)	1.00	8.00	12.00	52.00	2,704.00
Plasterer app. (4th year)	1.50	12.00	18.00	78.00	4,056.00
Plumber app. (5th year)	0.87½	7.00	10.50	45.50	2,366.00
Sheet-metal app. (8th 6 mo.)	1.40	11.20	16.80	72.80	3,785.60
Struct.-iron app. (4th 6 mo.)	1.50	12.00	18.00	78.00	4,056.00

LABOR MANAGEMENT DEFINED

"Labor management" has to do with the control of all those human factors which affect production, and its field is in effect bounded by these human elements. "Labor relations" in its broad sense is synonymous with "labor management." However, in its narrow and generally accepted sense, "labor relations" is only concerned in the rather involved relationships with organized labor. "Labor management" as considered here includes "labor relations" as one of the factors that affect labor production. The main objective of "labor management" is to speed up construction and reduce labor costs through acceptable common-sense methods. This reduction in labor costs results in more construction and increased returns to labor.

In the writer's experience, it has been found possible to save a third of the labor cost in dollars or man-hours through good labor management. The exact extent of labor savings possible makes little difference from the standpoint of this discussion as, in any case, the margin of savings in man-hours or dollars is substantial and warrants definite attention. On the assumption that labor costs run one-half of the total costs, such savings would be one-sixth of the total cost in dollars.

POSSIBLE SAVINGS ANALYZED

Possible savings in manpower and dollars through a systematic method of labor management are shown in Fig. 4. The greatest savings must result on the project itself where the labor performs. Out of a total labor savings of 33⅓%, approximately 30% is creditable to activities at the project. Of this 30%, approximately

5% can be assigned to factors outside the project site, 20% to factors inside the project, and the remaining 5% to labor relations that prevail for the specific project.

Again referring to Fig. 4, it will be noted that a possible remaining credit of 3 1/3% has been assigned to the central office—usually located in Washington. Of this total, it is not unreasonable to assume that 2% of the savings in labor cost for each project is creditable to labor relations activities. Many of the labor relations functions can only be performed by the central office because organized labor is also centralized, and it is both desirable and necessary to coordinate labor relations activities between these top offices in order to assure a broad application of policy.

Only 1 1/3% of the possible savings in project labor cost has been credited to production factors performed at the central office. This element, while a small part of the project saving, is absolutely essential because leadership and coordination of labor production savings must originate in, and be maintained by, the central office.

If indeed a 3 1/2% saving in all project labor costs could be credited to the central office, the aggregate saving involved would approximate $30,000,000 during the present year. This figure is computed on the estimated labor cost in construction for 1943–1944, as shown in Fig. 3. Labor relations performed by the central office could ideally save 2% on $36,000,000 for the same period. Labor relations alone, even in its moderately developed state, can with good judgment save many millions each year.

COORDINATION OF GOVERNMENT AGENCIES

At the present time, practically all large construction projects are government owned or controlled. This situation has existed over the past two years. From the viewpoint of the worker, it would be very desirable to have a uniform situation as to wages and working conditions in any given area. This uniformity should prevail regardless of the government agency or type of contract. Such a condition would also be extremely valuable from the standpoint of the government agencies as regards labor usage and economy.

Unfortunately, in most localities, the ideal of uniform labor conditions has not been attained to any great extent. Even the minimum wage rates set by the Department of Labor vary to some extent with each new determination. Until the passage of Executive Order 9250, there was no effective brake on maximum wages and salary rates. This freeze order has in many cases been sidestepped either by direct violation or by payment of overtime and travel allowances. Lump-sum contractors, who even now are largely unregulated, have bid for labor against fixed-fee contractors, and project has bid against project. This competitive situation has been taken advantage of by organized labor and has had the net result of spiraling wage and salary rates.

It is to be noted that construction work is carried on to a greater or less extent by some 35 government agencies. Each agency approaches the problem in its own way. Only a very few have information readily available as to expenditures and employment. The number of agencies involved is an additional reason why engineers should participate in the administration of the labor problem, because the engineer through his intimate knowledge of construction and his common-sense approach, could attain some semblance of coordination as to labor, among all the government agencies concerned.

The larger government construction agencies have coordinated their labor problems to a considerable degree through their labor relations offices, with material beneficial results. Yet each has been fundamentally independent and a great deal remains to be accomplished.

BACKGROUND OF KEY PERSONS

The background of the administering individuals is a large factor in the coordination problem between government agencies. An approximate count of key persons involved shows the following background:

Attorneys	.28	Engineering construction	.5
Organized labor	.10	Miscellaneous	.11

The preponderance of attorneys in labor relations is accounted for by the fact that wage determinations have to be applied for under the Davis-Bacon law.

The labor problem in construction should be handled by engineering construction men because of their background and first-hand knowledge of the conditions on the job. While engineers are in the minority at present, it is hoped that the situation will improve in the future.

NOTE: *These discussions represent the opinions of the author, and do not necessarily reflect the policies or attitudes of any government agency.*

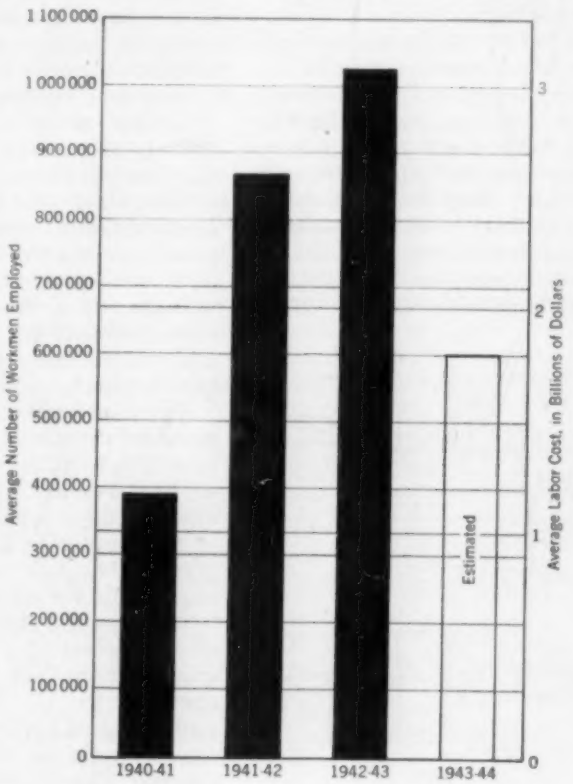


FIG. 3. WORKMEN EMPLOYED BY ALL GOVERNMENT AGENCIES AND TOTAL WAGES PAID

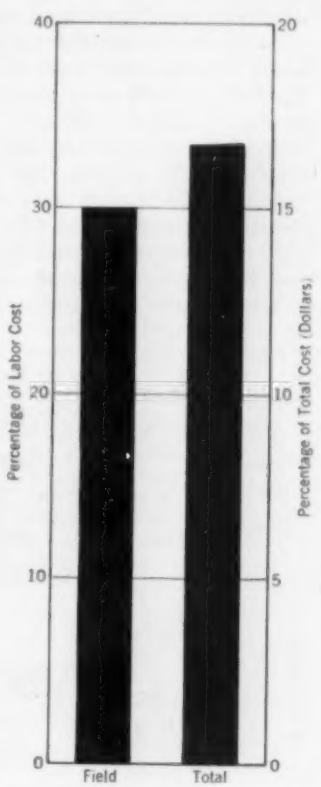


FIG. 4. SAVINGS POSSIBLE THROUGH LABOR MANAGEMENT

Discharge of Pipes Flowing Partly Full

Data Developed by a Research Project of the Division of Irrigation, Soil Conservation Service

By Carl Rohwer, M. Am. Soc. C.E.

Irrigation Engineer, Division of Irrigation, Soil Conservation Service, Colorado Experiment Station, Fort Collins, Colo.

It is generally believed that the discharge of a horizontal pipe flowing partly full is a definite function of the depth of water at the outlet. However, recent tests indicate that there are limitations to the depth for which a simple relation holds. For example, at less than half the pipe diameter, the discharge is directly related to the depth but for greater depths the flow is unstable and may occur at several different velocities. The basis for this conclusion and a new flow formula for depths less than half the pipe diameter are here given.

CONTRARY to a widespread impression, the discharge of pipes flowing partly full does not follow a smooth variation in relation to depth. In fact, an extended study has revealed that there is a pronounced break in the discharge curve for depths greater than half the diameter. The flow is then variable and depends on conditions the nature of which has not been definitely determined. As a result, measurements made at depths of more than half the pipe diameter may be considerably in error.

In 1922 Van Leer reported the results of tests on the discharge of standard pipes flowing partly full, and in 1924 supplemented this from similar tests on well casing ("The California Pipe Method of Water Measurement," by Blake R. Van Leer, *Engineering News-Record*, Aug. 3, 1922, pp. 190–192, and Aug. 21, 1924, p. 293). The tests on standard pipes were limited to small sizes, 6 in. or less in diameter. A tee was used to connect the horizontal outlet with the vertical supply pipe, and the vertical branch of the tee was left open in order to give air free access to the water flowing in the horizontal pipe. The results showed a consistent relation between the depth and the discharge. A general formula for computing the discharge was developed on this basis.

A project recently started by the Colorado Agricultural Experiment Station required measurement of the discharge of all irrigation pumping plants in the South Platte Valley in Colorado. Because of drought and resulting lowering of the water table, some yields had decreased materially so that the discharge pipes were only partially filled. It was decided that the method of measurement described by Van Leer would be satisfactory for determining the discharge under these conditions, but that before it could be used, additional calibrations would have to be made on the larger sizes of pipe.

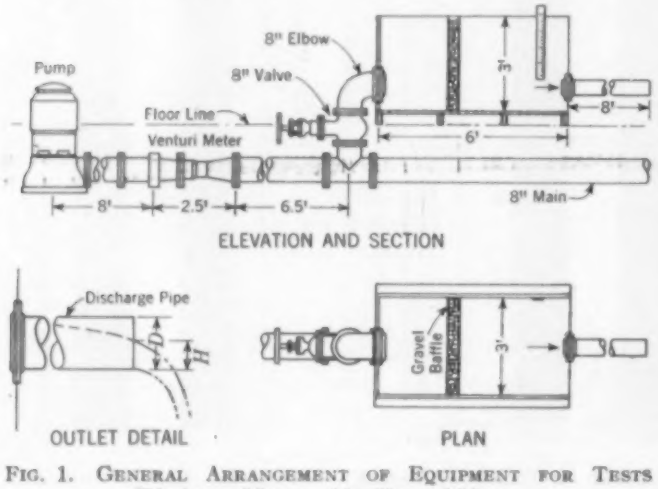


FIG. 1. GENERAL ARRANGEMENT OF EQUIPMENT FOR TESTS Discharge Measured by Venturi Meter

During the summers of 1940 and 1941, tests were made on the discharge of 4, 5, 6, 8, 10, and 12-in. standard pipe and 7, 8, and 9-in. well casing. Since normally there is no inlet for air into the discharge pipe of a pump, no provision for the entrance of air was made except during a series of special measurements. Two methods of verifying the flow were used—a venturi meter during the initial tests, and in the later ones at the Bellvue field Laboratory, a 2- or a 4-ft rectangular weir for large flows and a 90° V-notch weir for small flows. These devices had all been carefully checked by volumetric measurements before their use in this study. The equipment for making the tests checked by the venturi meter is shown in Fig. 1. A similar arrangement was used for the other tests, except that the pipes discharged into a pool from which the flow was measured by weirs (Fig. 2). Tests later than those of Fig. 1 determined the effect of different entrance conditions (see Fig. 3).

The depth of water flowing at the pipe outlet was obtained by taking readings to the nearest hundredth of a foot under most conditions, but to thousandths of a foot by estimation for small flows and smooth water surface. It was first thought that a single measurement at the center of the pipe would be sufficiently accurate for the calibration but it was found that the water surface was seldom level transversely, the difference between that at the center and that at the sides of the pipe being frequently as much as 0.05 ft. In addition, there was a decided surge, which made accurate reading difficult.

More consistent results were obtained when a series of measurements, consisting of from 3 to 5 readings, depending on the size of the pipe, was made across the nappe from the lower edge of a straightedge fixed just level with the top of the pipe bore. By this method the transverse profile of the nappe could be definitely determined and consequently a more accurate value for the depth was obtained.

Pipes of various lengths were calibrated. For the standard pipes of 4 to 12 in. in diameter, lengths ranged from $2\frac{1}{2}$ to 14 ft. Tests on well casing were made only on 10-ft lengths. For depths less than half the pipe diameter, there was apparently no significant difference in the discharge for the various lengths. For depths greater than half the pipe diameter, the pipe length was responsible for considerable variation in the results.

It was noted that, for all lengths, the discharge generally increased at a much slower rate after the depth exceeded about half the diameter of the pipe, as clearly shown in Fig. 4. This phenomenon was considered the more unusual because no mention of it was made by Van Leer nor did he show any such break in his discharge curves. The discrepancy was at first attributed to errors in reading the depth because of the disturbed condition of flow when the depth exceeded half the diameter.

However, two sets of tests, one on a 4-in. pipe and one on a 12-in. pipe, where the discharge was measured over small increments of depth, showed clearly the very definite breaks in the curves at the points indicated in Fig. 4.

While the tests were in progress, it was discovered that if the outlet was temporarily obstructed, under certain conditions the character of the discharge changed after the obstruction was removed; but thereafter it continued without change until the discharge was increased. This was attributed to the fact that when the flow was obstructed the pipe flowed full below the entrance, and that after the obstruction was removed, the partial vacuum at this point kept it flowing full. As a result the velocity was reduced and consequently the flow for a given depth was relatively less, as shown by the curves. The reason the two conditions of flow did not exist at depths below half the diameter was that the vacuum was not sufficient at low velocities to make the pipe flow full.

From this it was concluded that if an air inlet were provided, it would not be possible for the pipe to flow full below the entrance and consequently only one condition of flow at the outlet would be possible. Comparable tests on 12-in. pipes 6 and 14 ft long, with and without the air inlet, showed that for depths below the point where the break in the discharge curve occurred, the air inlet had no effect on the discharge; but that above this point the discharge increased at a faster rate than previously. This is shown by the solid dots in Fig. 4, which are for the tests on the pipe 14 ft long. Tests on a 6-ft pipe (not shown in Fig. 4), exhibited the same tendency.

When air is admitted into the pipe, the discharge increases much faster than a prolongation of the straight-line portion of the logarithmic plot would indicate, in spite of the fact that the rate of increase of the cross section of the water in the pipe is becoming slower at these depths. There is also a difference in the character of the flow under the two conditions that is readily apparent visually. Without the air inlet, the water leaves the pipe at moderate velocity and falls smoothly into the outlet pool. But with the air inlet in operation, the water shoots out almost horizontally. The discharge varies accordingly; in fact, for the same depth the discharge may be twice as great under one condition as under the other.

Flow under each of these conditions was observed also while the tests on the 8-in. pipe were in progress, but here the high velocity occurred naturally without special provision for air. The discharge was increased from one test to the next without obstructing the flow, and as a result the pipe apparently did not fill below the entrance at any time. During these tests the water was observed to shoot out of the pipe at high velocity. Afterward the flow was temporarily obstructed, and from then on the discharge occurred at low velocity, the points falling on the portion of the curve above the break (Fig. 4).

Why the discharge for the high-velocity flow was greater than anticipated is not definitely known, and since transparent pipe was not used, it was impossible to see what was actually occurring inside. However, the character of the flow indicated that the discharging stream was merely a continuation of the jet formed at the pipe entrance, and consequently would be practically independent of the outlet pipe except so far as it was affected by friction and the entrainment of air.

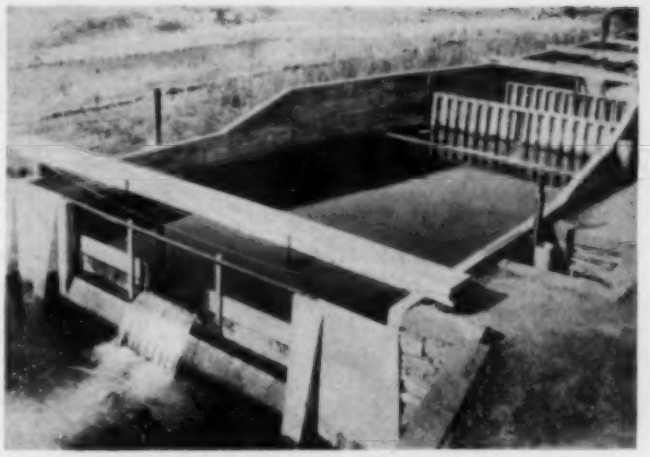


FIG. 2. WEIR AND WEIR POOL AT BELLVUE FIELD LABORATORY
Pipes Under Test Were Installed Upstream from Baffles

When flow occurred with such divergent results at depths exceeding half the diameter, it was decided to investigate the effect of changes in the entrance conditions. To simulate the pump outlets, a 12-in. pipe with a welded elbow (Fig. 3, *a*) was installed at the Bellvue laboratory. The tests were made as before, except that the discharge was measured by a 2-ft instead of a 4-ft rectangular weir. In the zone where the break in the discharge curve occurred, the flow was temporarily obstructed for a short period before each test in order to make the pipe flow full beyond the elbow if possible. The test results are plotted in Fig. 4 as half black circles.

Although this pipe was only 10 ft long, the circle symbol was used to avoid confusion because it was not believed that the difference in length would affect the results. The points follow in general the curve previously determined, but apparently there was an unstable condition at depths from 0.45 to 0.5 ft, where the flow could occur at either the high or the low velocity condition. This is clearly shown by the two points at the 0.5-ft depth. Above this depth the points again fall near the original curve, but since they are to the left of the curve, evidently the elbow has a retarding effect on the discharge for a given depth. However, these tests show that there is a definite break in the discharge curve at about the mid-depth of flow.

In 1942, when equipment was installed for testing the loss of head in suction pipes for pumps, it became possible to investigate the discharge from pipes flowing partly full with entrance conditions similar to those under which Van Leer made his tests. To study this condition, a 6-in. pipe was installed (Fig. 3, *b*). The 4-in. riser provided a standpipe which helped to dissipate the velocity in the vertical inlet and at the same time provided an air inlet. The results of the tests on this pipe are plotted as half black squares in Fig. 4.

For depths less than 0.28 ft, these points coincide with those previously

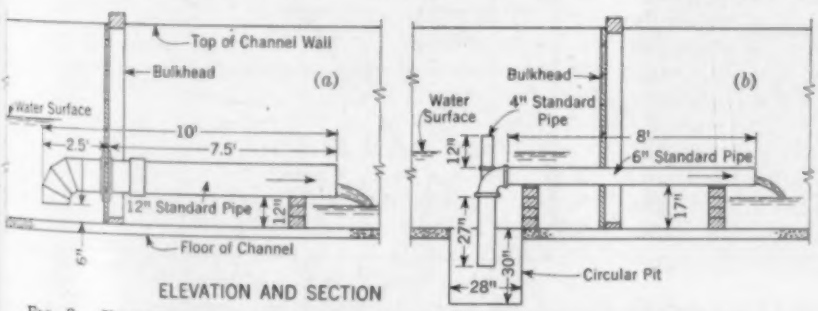


FIG. 3. EQUIPMENT FOR INVESTIGATING EFFECT OF ENTRANCE CONDITIONS
(*a*) 12-In. Pipe with Elbow; (*b*) 6-In. Pipe with Elbow and Riser

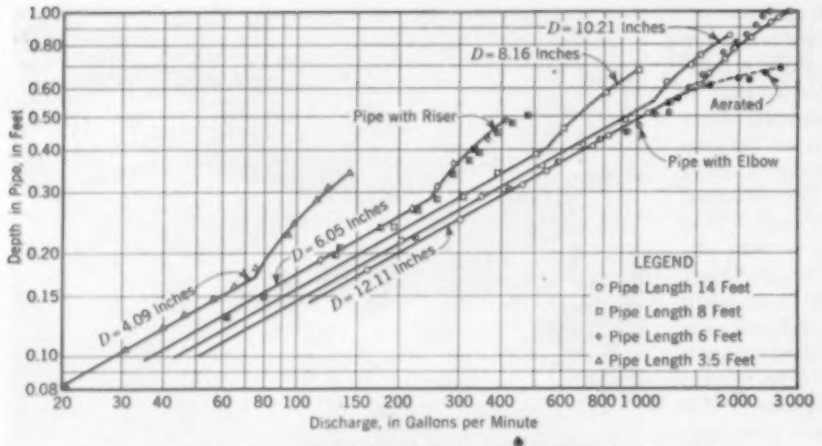


FIG. 4. DISCHARGE DIAGRAMS FOR 4- TO 12-IN. STANDARD PIPES FLOWING PARTLY FULL UNDER VARIOUS CONDITIONS

obtained. From the break in the discharge curve at this point, the points fall slightly to the right of the original line. This is attributed to the fact that the riser acted as an air inlet and consequently kept the pipe from flowing full beyond the elbow. The effect was not so conspicuous as in the 12-in. pipe with the air inlet, probably because there was some loss of head in the vertical riser. Here also the break in the discharge curve is at approximately the mid depth.

Since all the curves below the breaks are straight lines on logarithmic paper, the general formula for discharge at depths less than half can readily be determined. The form of the equation for the lines is $Q = KH^n$, where Q is the discharge in gallons per minute; H, the depth in feet at the outlet; n, an exponent depending on the slope of the lines; and K, a constant for each diameter of pipe. The slope n of all the lines is the same and is equal to 1.82. The constant K is different for each size of pipe because it is a function of the pipe diameter and is equal to $790D^{2.62}$, when D is the diameter of the pipe in inches. The general formula then becomes

$$Q = 790D^{0.62}H^{1.82}$$

The straight portions of the curves in Fig. 5 were computed by this formula.

For convenience in the field, where frequently the only available scales are graduated in inches, the formula for Q has been converted for measurements in inches, as follows:

$$Q = 8.58D_i^{0.62}H_i^{1.82}$$

Since this formula is not convenient for computation in the field, Fig. 5 was prepared, from which it is possible to read the values of $8.58D_i^{0.62}$ and $H_i^{1.82}$ directly. The discharge in gallons per minute is the product of the two values. It should be kept in mind that the diagram cannot be used to find the discharge when the depth is greater than half the diameter of the pipe, or when the pipe is not horizontal. If the depth exceeds half the diameter, then the pipe should be obstructed temporarily to insure flow at the low velocity stage. The approximate discharge can then be read from the upper part of the discharge curve, Fig. 4. This method is not recommended for use where accurate results are required, but it does provide a simple way to obtain a reasonable estimate of the discharge when no better methods are available.

The results of the tests reported by Van Leer do not check the data shown in Fig. 4. His pipes were provided with air inlets, but this should not affect the results below the point where the breaks in the curves occur because below this point the condition of flow is the same whether the pipe is aerated or not. His discharge curves have practically the same slope as those in Fig. 4, but they are offset an appreciable distance. A high degree of accuracy cannot be expected from this method because errors of from 0.01 to 0.02 ft are possible in measuring the depth. There is a pronounced surging in the flow, which increases as the depth increases, and at the same time the nappe may not be smooth and level transversely, thus adding to the difficulty of measuring the depths accurately. Since, however, the tests here reported were made under a wide variety of conditions with quite consistent results for depths less than half the diameter, it is believed that under these conditions satisfactory measurements of the discharge can be obtained by the use of the formulas or diagrams.

ACKNOWLEDGMENTS

This study was conducted by the Division of Irrigation, Soil Conservation Service, in cooperation with the Colorado Agricultural Experiment Station, under the general direction of W. W. McLaughlin, chief of the Division. The author wishes to acknowledge the assistance of W. E. Code, irrigation engineer, Maxwell Parshall, meteorologist, and N. Christenson, Assoc. M. Am. Soc. C.E., chairman of the Engineering Section, Colorado Agricultural Experiment Station.

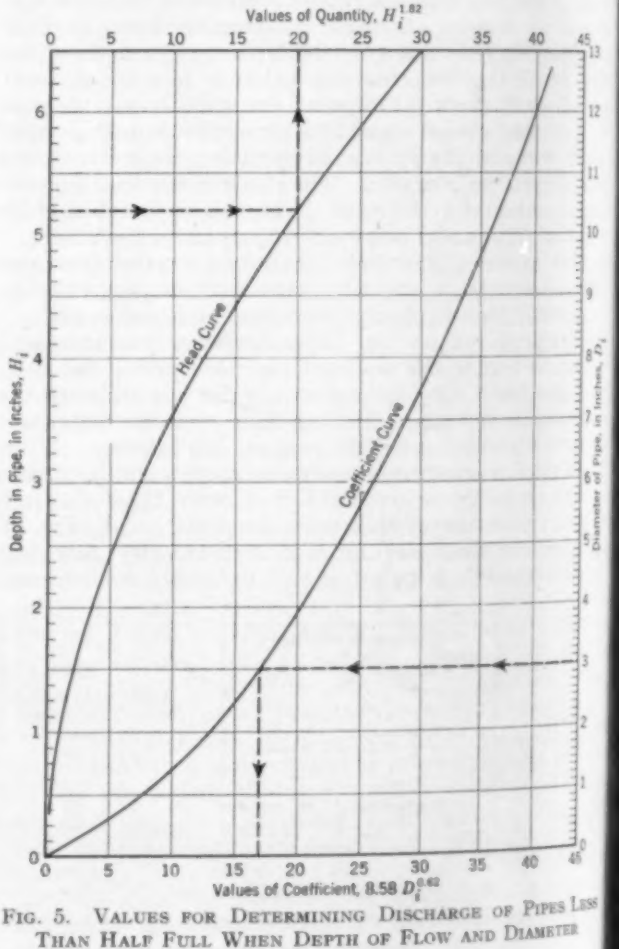

Values of Quantity, $H_i^{1.82}$
Head Curve
Coefficient Curve
Depth in Pipe, in Inches, H_i
Diameter of Pipe, in Inches, D_i
Values of Coefficient, $8.58\ D_i^{0.62}$

FIG. 5. VALUES FOR DETERMINING DISCHARGE OF PIPES LESS THAN HALF FULL WHEN DEPTH OF FLOW AND DIAMETER ARE IN INCHES

Comprehensive Program of Cement Research

Progress in Far-Reaching Investigation, Extending from Manufacture to Actual Use

By F. R. McMillan, M. Am. Soc. C.E.

Director of Research, Portland Cement Association, Chicago, Ill.

PORTLAND cement is a widely used and much abused material. The long-standing need for a broad investigation is being met by the extensive work here described. A program covering a number of years seeks intensive information in three phases—cement manufacture, behavior in field structures, and complete laboratory tests. To state that the plan calls for an eventual expenditure of over $350,000 and processing of almost 100 carloads of cement gives some idea of the scope of the research. This paper has here been brought up to date—following its original presentation before the Metropolitan Section of the Society.

AN exhaustive program covering cement performance in concrete is under way. Its objectives are to find, first, what differences occur under comparable conditions of use, and second, what characteristics or properties of the cements are responsible for such differences. This investigation followed the suggestion of P. H. Bates, of the National Bureau of Standards. Following a grant of over $350,000 by the Portland Cement Association, a program was adopted in August 1940, as developed by a representative advisory committee under the chairmanship of Mr. Bates. The objectives are three: (1) careful collection of American cements, (2) long and varied tests in structures, and (3) comprehensive laboratory studies.

SELECTION OF CEMENTS—FIRST PHASE

This whole project was to be principally a study of the effect of cement characteristics on the durability of concrete. To secure results truly representative of the performance of cements produced under normal manufacturing procedure, and to insure the widest possible acceptance and application of the findings, the Advisory Committee felt it desirable to use the regular products made from raw materials which the manufacturer customarily used.

There were practical limits to the number of cements that could be included. With freight as high as $1,500 per car, the cost on 90 cars in carload shipments, and many tons shipped in less than carload lots, represented nearly 20% of the entire outlay for the program.

Briefly, the 27 cements were so selected as to cover: (1) types recognized by the 1941 specification of the American Society for Testing Materials, (2) wide range in chemical composition, (3) good geographical distribution and representative raw materials, (4) several types from the same plant and the same raw materials, and (5) treated and untreated products.

The geographical range included Hudson, 2; Lehigh Valley, 6; Southern States, 6; Central States, 8; and Texas and the Far West, 5. Treated cements were ground with 0.04% Vinsol resin, using exactly the same clinker as for the corresponding untreated cement.

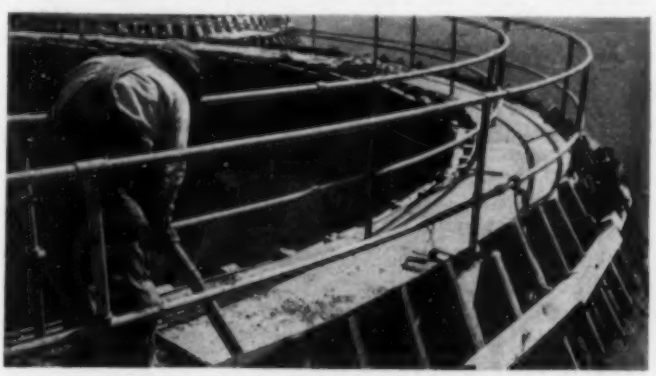
A special party under Dr. W. C. Hansen, of the research staff of the Portland Cement Association, was organized for the collection of data during manufacture. Work started in December 1940, and was completed in June 1941. From 4 to 7 technicians were present at each plant during all the operations, to obtain a complete record of the pertinent facts connected with manufacture. Samples of raw feed and clinker were taken at regular intervals, usually each half hour. Each kiln was sampled separately. Kiln temperatures were obtained with recording pyrometers. The temperature of the cement as it came from the finishing mill was observed, and grab samples were taken at half-hour or shorter intervals. At the time of packing for shipment, 100 bbl of each of the 27 cements were carefully preserved in sealed steel drums for complete laboratory study.

In general, the program required from 1,300 to 1,900 bbl of each cement, but only 450 bbl for three of the treated ones. Six-thousand 30-gal drums, and over 20,000 smaller metal containers of all sizes, were required for the various samples. Special 6-ply, asphalt-lined paper bags were used in shipping cement to the different projects.

The second or construction phase might be called the "backbone" of the long-time study. There have been many efforts to compare field performance of different cements, but few instances involving only actual differences between cements. A change of cement during construction does not of itself provide a satisfactory comparison unless all the other factors, including weather, remain constant.

Therefore the aim was to build a series of structures so as to afford a fair comparison of the performance of many cements over a period of years. Recognizing that it is impossible in work extending over several weeks to eliminate entirely changes in weather or other conditions, a cardinal principle was to use each cement several times in each structure or series of structures.

Not all of the cements were used in all the structures, but the entire 27 were used 78 times and 22 were used 95 times. These figures do not include 48 additional comparisons offered by the exposure of small beams (6 by 6 by 30 in., or 5 by 5 by 34 in.) to very severe climatic conditions or to strong sulfate soils. This large number of repetitions should eliminate the possibility that any one cement or type will receive an unfair distribution of either the favorable or unfavorable breaks. Periodic inspections will be made of all structures so that a continuous record can be had of the development of any weathering or service defects.



Vibrating Freshly Placed Concrete on Multiple Arch Dam in High Sierras

TABLE I. EXPERIMENTAL ROAD PROJECTS

Tests Sections	Total Length, Miles	Construction Period		Actual Days Worked	Cements Used		Length of Test Sections, Ft
		Started	Finished		Number	Repetitions	
Built during 1941:							
Missouri	1.8	7/31	8/8	8	24	5	75
South Carolina	1.9	10/16	11/5	15	24	4	90
Built during 1942:							
New York	2.6	8/15	10/9	30	18 6 3	4 12 8	150

In three major projects (Table I) test roads were built in cooperation with the U.S. Public Roads Administration and state highway departments. All were constructed under contract as usual, except that the special cements were used in short sections in rotation either four or five times. The designs of slabs and concrete mixes were all standard, also the aggregate used.

During construction the Association had a large field party under I. L. Tyler, M. Am. Soc. C.E., collecting samples, making moisture and unit-weight determinations, slump tests, and temperature measurements of the slab, and detailed observations on the bleeding and finishing characteristics of the concrete.

Each of the three test roads used one car each of 24 cements. In addition, special treatment for the New York project called for 15 cars of nine of these cements and three cars of three treated cements, or a total of 42 carloads on this test road (Table I).

The handling of the cements was complicated by the requirement that each was to be used four or five times. Thus, before the work started all the material had to be available. On the Missouri project, completed in 8 days, the cement was handled directly from the cars to the mixing plant. In South Carolina and New York, special warehouse facilities were required for storing.

For exposure to fresh and salt waters, 222 reinforced concrete piles were made. These were 12 by 12 in. in cross section and 20 to 30 ft in length, built by contract at convenient locations and transported by train or truck and barge to points of installation. All operations were designed to give the greatest possible uniformity. To avoid cracking from shrinkage or driving, the piles were kept continously wet from the time of casting, and were jetted into place.

For each location three piles were made with each cement (Table II), as follows:

(1) 5 sacks cement per cu yd, 2-in. slump, vibrated
(2) 7 sacks cement per cu yd, 2-in. slump, vibrated
(3) 7 sacks cement per cu yd, 8-in. slump, hand placed

During the casting of the 132 piles for the Hudson River and Cape Cod Canal, two 6 by 6 by 30-in. specimens were made for each mix with each cement. They are now under exposure at Treat Island, Eastport, Me., are inspected every two weeks, and have their natural period of vibration determined at convenient intervals.

Commonly, concrete in handrails, parapet walls, and similar thin sections is the first to show the effects of weathering. To investigate such structures, several projects are planned, but only the first has been completed. This consists of repairs to the walkway along the top of a multiple-arch concrete dam built in 1925–1926 in Southern California. Because of the high altitude (7,300 ft) and the heavy snows, horizontal surfaces are subject to almost daily cycles of freezing and thawing in a saturated condition from December to May, and the walkway has scaled and raveled badly. Various methods of protection and repair have been tried.

For this experiment, the disintegrated concrete was chipped away and new concrete placed, using the 27 test cements. Each cement was used three different times in sections 10 ft. in length, the concrete having the following characteristics: $6\frac{1}{2}$ sacks cement per cu yd; natural sand and gravel aggregate of $\frac{3}{4}$-in. maximum size; slump of 2–3 in.; placed by vibration.

During the placing, 5 by 6 by 34-in. beams were made as control specimens, six for each cement. One-third are stored on top of the walkway, one-third where they will be submerged in the reservoir from May until December, but exposed to snow and ice during the winter months; and one-third in a protected location near the dam site. Measurements of the natural frequency of vibration will be made in the spring and fall, when all the specimens are accessible.

TABLE II. TEST PILES

Location of Test	No. of Cements Used	No. of Piles	Point of Manufacture
Cape Cod Ship Canal, Mass.	22	66	Franklin Park, Ill.
Hudson River, N.Y.	22	66	Franklin Park, Ill.
Salt Run, St. Augustine, Fla.	22	66	Jacksonville, Fla.
Newport Bay, Calif.	8	24	Los Angeles, Calif.

All 27 cements are being used in a study of exposure to strong alkali soils at Sacramento, Calif., under the following conditions:

3 mixes, all vibrated, $1\frac{1}{2}$-in. slump, with respectively 4, $5\frac{1}{2}$, and 7 sacks of cement per cu yd
Specimens: 5 by 6 by 34-in., embedded 3 in. in soil with the 6-in. dimension vertical
Soils to be alternately wet and dry
Two types of soil: 9% sodium sulfate, 1% magnesium sulfate
7% sodium sulfate, 3% magnesium sulfate
Total of 1,200 specimens, including control specimens, for air storage
Six specimens of each mix in each type of soil
Relative performance to be determined by measurement at regular intervals of the natural frequency of vibration and weight losses, and by surface indications of disintegration

Specimens for this series were made in the laboratory of the state highway department. This gave a uniformity of control that would have been impossible in a field operation.

EXPERIMENTAL FARMS INDICATE WEATHERING

On so-called experimental farms, a large number of near "job-size" specimens are exposed to normal weathering. One farm is located near Chicago in northern climate, and the other near Perry, Ga., in a southern climate. The principal purpose is to provide comparisons of the 27 cements with different aggregates and over

SINGLE-LANE CONSTRUCTION WITH 27E PAVER ON A NEW YORK STATE TEST ROAD SECTION

a range of mixes and consistencies, selected to give concretes of good, intermediate, and inferior quality. Such comparisons were not possible on the road or dam projects, and only to a limited extent with the piles. Each farm is to test:

Columns or posts, 8 by 60 in. set vertically 2 ft in ground, a type of exposure commonly encountered

Slabs $2^1/_2$ by $3^1/_2$ ft, 6 in. thick, cast in place to simulate exposure in a road slab

Open box-like specimens, $2^1/_2$ by $2^1/_2$ ft in outside dimension, to be filled nearly to the top with earth and part of the time with water (intended to simulate exposure of a concrete retaining wall)

Composition of the specimens is given in Table III.

TABLE III. COMPOSITION OF SLABS, BOXES, AND COLUMNS

	Aggregate Combinations	No. Mixes For Each	Sacks Cement per Cu Yd	Slump in In.	How Placed
Slabs	3	3	6	3	Hand
			$6^1/_2$	3	Hand
			$6^1/_2$	8	Hand
Boxes and columns	2	6	6	3	Hand
			6	$1^1/_2$	Vibrated
			6	8	Hand
			$4^1/_2$	3	Hand
			$4^1/_2$	$1^1/_2$	Vibrated
			$4^1/_2$	8	Hand

One of the three aggregate combinations used in the Illinois slabs was identical with that used on the Missouri test road, one was identical with that used on the New York test road, and the third was a local gravel of good quality combined with a sand from New York State which was once quite extensively used but which is not acceptable under current specifications. This sand was selected because of its unsatisfactory record. At the Georgia farm one of the slab aggregate combinations was identical with that used on the South Carolina test road; the other two were combinations of local materials of good quality. For the boxes, combinations of both good and poor materials were used. Thus, in providing many combinations for the comparison of the 27 test cements, the practical possibilities are fairly well covered.

LATEST INVESTIGATION COVERS WEATHERING

During 1943 one additional project, utilizing thin sections exposed to severe weathering, has been completed. This involved the construction of 104 sections of a parapet wall, 3 ft 9 in. high, 16 in. thick, and 10 ft long, on Green Mountain Dam (El. 8,000 ft), near Kremmling, Colo. This is a U.S. Reclamation Bureau project, built under contract by the Warner Construction Company.

Of the test cements, 24 were used either three or four times in mixes containing 6 sacks per cu yd. Aggregates were natural sand and two sizes of gravel. The concrete was placed by vibration (slump 2 to 3 in.).

During the construction, 168 cylinders 6 by 18 in. were made for exposure as follows: one-third of the specimens on top of the dam; one-third on the face of the dam, to be part of the year below water level and part of the year above it; and one-third in a protected storage place near the dam site. Measurements are being made on these specimens at regular intervals for natural frequency of vibration.

TYPES OF TEST STRUCTURES ON AN EXPERIMENTAL FARM

One of the most important main features of the porgram is the series of exhaustive laboratory tests of the cements. Only by using the results of such a study will it be possible to explain the differences in behavior that may develop from the exposure tests. All the recognized physical and chemical tests for portland cement and clinker are being carried out, as well as many others not ordinarily made, some entirely new. Petrographic studies of the clinkers are unusually extensive. In all this work, individual grab samples as well as composite ones are being studied.

Of the 100-bbl samples in sealed metal drums, a good portion will be preserved indefinitely. Thus at any time in the future, if questions arise concerning the behavior of the field structures, ample quantities of the original cement will be available for test. This will meet the need felt by every investigator studying the performance of old concrete structures.

A further and more important use for these reserve samples will be in the evaluation of new tests for portland cement which may be proposed or devised at any time in the future. For the first time in history, there will be available what we might term a "library of samples" for which the manufacturing history is known, as well as a record of performance in a variety of structures under various exposures and climatic conditions. With such a record as a background, these cement samples should provide a medium by which the new test procedures can be more readily and intelligently evaluated.

MANY HAVE ASSISTED

Acknowledgments for valuable cooperation are due to W. L. Chadwick, M. Am. Soc. C.E., on the high-altitude dam work; to Thomas E. Stanton, M. Am. Soc. C.E., on the Sacramento tests; and to C. E. Wuerpel, of the U.S. Corps of Engineers, on exposure specimens from the pile tests. Special acknowledgments are due the U.S. Public Roads Administration and the Highway Departments of New York, Missouri, and South Carolina, for making possible the three major projects, and for fullest cooperation during construction. Members of the Advisory Committee under Mr. Bate's chairmanship include R. F. Blanks, R. W. Carlson, P. J. Freeman, T. E. Stanton, and B. W. Steele, members of the Society, also F. H. Jackson, and R. B. Young; representing the industry, Messrs. R. G. Uhlig, Hubert Woods, and R. N. Young, also F. R. McMillan, M. Am. Soc. C.E.; and ex-officio, Frank T. Sheets, M. Am. Soc. C.E.

LOADING 30-FT PILES AT FRANKLIN PARK, ILL., FOR HAULING TO CAPE COD SHIP CANAL

Engineers' Notebook

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

A Nomograph for the Integration of Stream-Flow Records

By PAUL B. JOHNSON

CIVILIAN PUBLIC SERVICE CAMP NO. 76, CALIFORNIA FOREST AND RANGE EXPERIMENT STATION, FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE, GLENDORA, CALIF.

ONE of the fundamental quantities in the analysis of stream-flow data is the amount of water delivered by the stream past a given point during a given time interval. Stream gaging station records give the rate of flow which, when multipled by the time interval, indicates the total volume of stream flow. This product must then be multiplied by a constant to convert to the proper unit, as cubic feet, acre-feet, or inches in depth over the watershed. In a stream-flow analysis this double multiplication consumes considerable time, and any short cuts and time-saving techniques are well worth adopting. The nomograph, Fig. 1, was developed to save time in this operation.

In the San Dimas Experimental Forest, stream-flow measurements are made in cubic feet per second, and the time intervals are noted in minutes. (See "The San Dimas Experimental Forest," by C. J. Kraebel and J. D. Sinclair, *American Geographical Union Transactions* of 1940, pp. 86–92.) The total stream-flow in cubic feet is determined by multiplying the average flow by the time interval by 60. The nomograph converts the average flow directly into cubic feet of stream flow for any rate of flow and any period of time. This flexibility makes the nomograph particularly useful in a region like Southern California, where the streams vary from flood to dry in a single season.

The nomograph (Fig. 1) consists of two equal logarithmic C-scales at the sides with a logarithmic A-scale in the center, which is placed so that 60 is on a level with 10 on the outer scales. As on a slide rule, only the significant figures in any reading are given.

To compute the amount (cubic feet) of total stream flow produced by an average rate (cubic feet per second) for an interval of time (minutes), connect by a thread, or a straightedge, the number of minutes on the right logarithmic scale with the average rate on the left scale. The total stream flows appears on the middle scale where the straightedge crosses. The formula may be written: total stream flow = 60 × rate × time.

It is sometimes difficult to estimate the position of the decimal point in the product of three factors. Until a computer becomes accustomed to using the nomograph, he can determine the number of digits before the decimal point in the answer by the following procedure. The average rate will fall in one of the columns numbered 0, 1, 2, 3, 4, depending upon whether the rate lies between 0.01 and 0.1, between 0.1 and 1.0, between 1.0 and 10.0, between 10.0 and 100.0, or between 100.0 and 1,000.0, respectively. These limiting values are given for each column at the top and the bottom of the rate scale. Thus the rate of 3 cu ft per sec lies between 1.0 and 10.0 cu ft per sec and will therefore fall in the rate column numbered 2. In the same way the time, 30 min, lying between 10 and 100 min, will fall in the time column numbered 1. The total stream flow, as determined by the straightedge on the center scale, will fall in one of three regions, numbered 0, 1, or 2. More columns may be added if the time interval is greater than 1,000 min or the rate greater than 1,000 cu ft per sec.

The sum of the numbers of the rate column, the time column, and the region gives the number of digits before the decimal point in the total stream flow. For example,

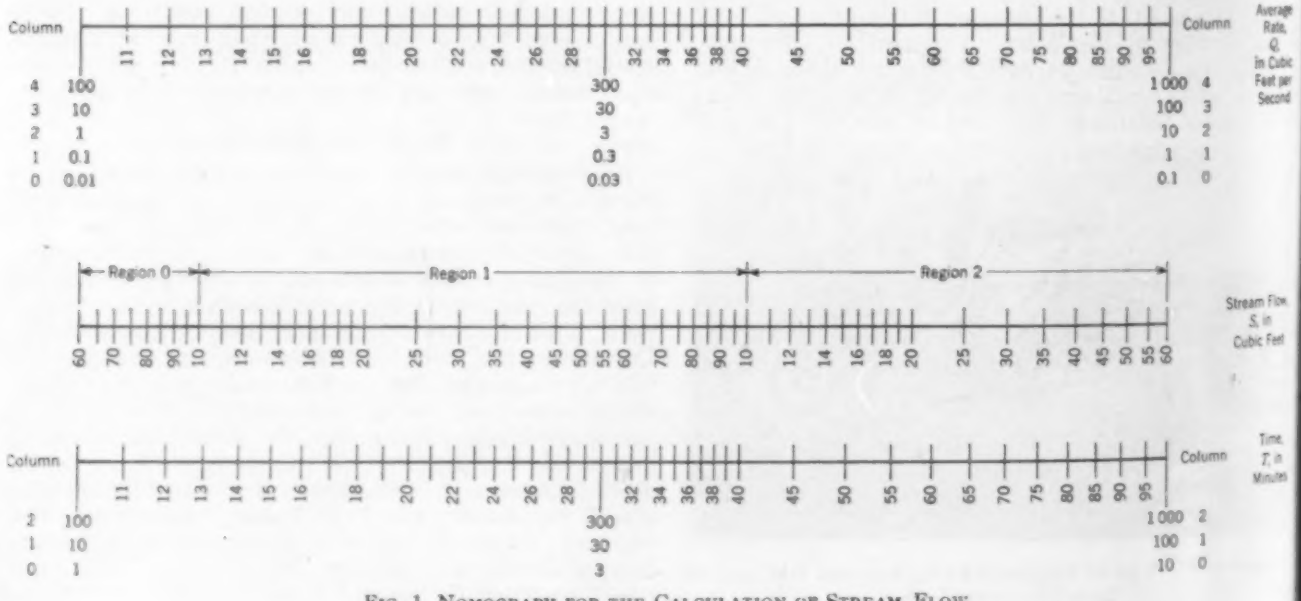


FIG. 1. NOMOGRAPH FOR THE CALCULATION OF STREAM FLOW

suppose that during a period of 630 min the average flow is 2.54 cu ft per sec. Alining 63 on the right (time) scale with 254 on the left (rate) scale, the straightedge crosses the middle scale at 960; 630 falls in time column 2; 2.54 falls in rate column 2; and 960 falls in region 1. The total will thus be 5. There will be five digits before the decimal point, and the total stream flow will be 96,000 cu ft. By multiplication, the exact answer is found to be 96,012 cu ft.

In laboratories where a great many calculations are being made, computers find that their speed with this nomograph almost equals their speed with calculating machines when used with a table of multiples of 60. Their speed is substantially greater than that with a slide rule or a machine without such a table. Where machines are not available because of expense, priorities, or other reasons, the nomograph will be a very valuable and inexpensive aid.

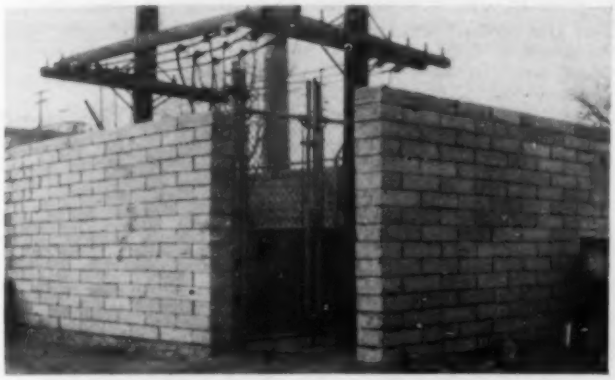
In the computing room, a 14 by 20-in. nomograph is used for greater ease and accuracy. It has been found that this nomograph can be read to an error of less than 0.5 of 1%.

Waterproofed Adobe Bricks for Revetment

By G. E. DEWSNAP

SERVICE ENGINEER, AMERICAN BITUMULS COMPANY

SUN-dried adobe bricks, in which approximately 6% of emulsified asphalt has been admixed for waterproofing purposes, are now being made by a number of manufacturers. They are used in the construction of



A PROTECTIVE WALL OF ADOBE LAID UP WITHOUT MORTAR

revetments and protective walls around tanks, transformers, and other vital points. The same mixture of soil and emulsified asphalt is also used extensively in the filling of burlap bags for revetments and also for slope protection. The material in the bags is usually moist when the bags are placed in walls or on slopes, and this permits the sacks to be fitted snugly together. The stabilized mixture in the bags dries when exposed to the air. Long before the bag has rotted away the stabilized soil has dried out and become highly resistant to water erosion. Walls that have been in use for six or seven years in waterways still show the marks of the burlap fabric, which disappeared after the first five or six months.

Stabilized blocks or sun-dried bricks of this material are easily handled and can be laid up with or without mortar. As the color of the finished brick closely resembles that of the natural soil, camouflage is sometimes unnecessary. Walls built with this emulsified asphalt stabilized soil, either in bags or in blocks, are highly resistant to machine-gun fire and also to shell fragments. As compared

REVETMENT OF STABILIZED ADOBE IN BURLAP BAGS

with sand-bag protection, they have the advantage of eliminating the constant replacement required when the bags rot. For this reason they would be equally valuable in flood protection work.

Welding Repairs to Steel Railroad Bridges

By WALTER A. ROOF

ENGINEER OF BRIDGES AND BUILDINGS, CHICAGO GREAT WESTERN RAILWAY COMPANY, CHICAGO, ILL.

OUR railway systems face a very serious problem in providing adequate transportation service to meet the requirements of normal business plus the emergency requirements of the National Defense Program. These systems are important cogs in our general defense machine. Thus they must be well maintained and they must have well-trained employees to carry out the required transportation program.

Steel bridges suffer greatly from deterioration caused by brine drippings from refrigerator cars, especially in spaces just outside the two rails. The parts affected are stringers, floor beams, lateral plates, bracing, webs of through-plate girders, bottom chords of truss spans, and top flanges of deck-plate girders. In most cases entire reconstruction is not necessary, and satisfactory repairs can be made in the affected zones by replacing riveted sections or by welding in replacements.

In the conventional rivet method, entire new prefabricated parts are required. Shop detail drawings have to be made and, because of the small tonnage, the shop cost is excessive. The field erection work involves a lot of equipment, such as compressors, rivet busters, riveting hammers, heating furnaces, and a vast list of small tools and fitting-up bolts.

On the other hand, with the welding process all that is needed, are a portable arc-welding machine, electrode material, clamps, and a supply of plates and angles, which may be second-hand materials and which do not have to be of the same size and thickness as the original piece so long as they are as heavy or heavier. In either method, the old parts have to be removed by taking out the existing rivets; the common method of doing this is by burning off the rivet heads.

Recent repair work of the Chicago Great Western Railway Company furnishes examples of the savings ef-

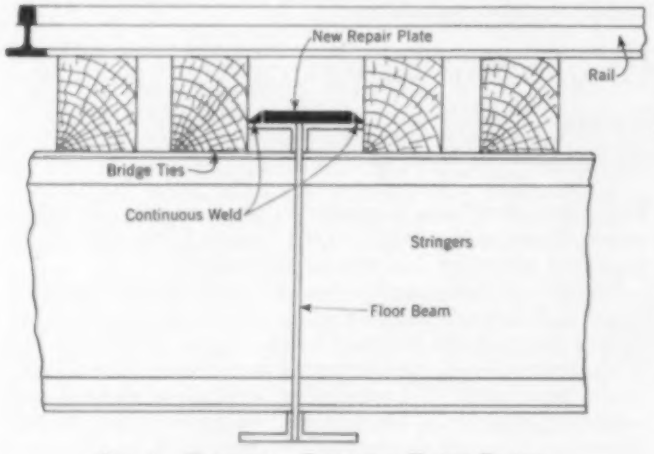


FIG. 1. REPAIR OF CORRODED FLOOR BEAMS

fected by welding. The top flange angles of the 7 floor beams of a deck-truss span were badly reduced in section. These were repaired by installing second-hand cover plates as shown in Fig. 1. Had this job been done in the ordinary way it would have been necessary to furnish new angle irons with exact hole punching, field connection bolts, and new rivets. The work would have required removing a great number of rivets and replacing them with field bolts until all the rivets were out. Then all the bolts would have had to be removed and the new angles put in and bolted, after which the bolts would have had to be taken out and replaced with rivets. To get at this work the bridge ties would have had to be moved and then replaced when the work was completed. All these operations take time and would have had to be done so as not to interfere with railroad traffic. It is quite evident that the arc-welding method is much simpler, as none of this work had to be done. The new plates are merely set on and then welded to the existing metal.

On a through-plate girder span the plates connecting lateral bracing to girder flanges became badly corroded

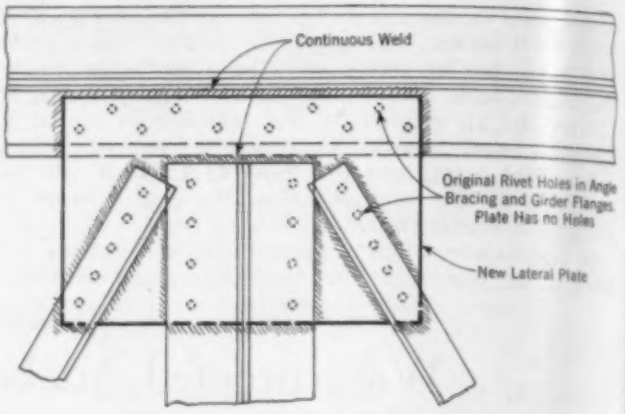


FIG. 2. LATERAL PLATE REPLACEMENT

and the rivets loosened. For replacement, used plate was flame cut to size and arc welded into position (Fig. 2). In other similar cases, where restoration of rivets only was necessary, the method shown in Fig. 3 was used.

Experience has shown that the cost of repairing steel bridges by arc welding runs from about one-third to one-half the cost of riveting. Because of the impossibility of

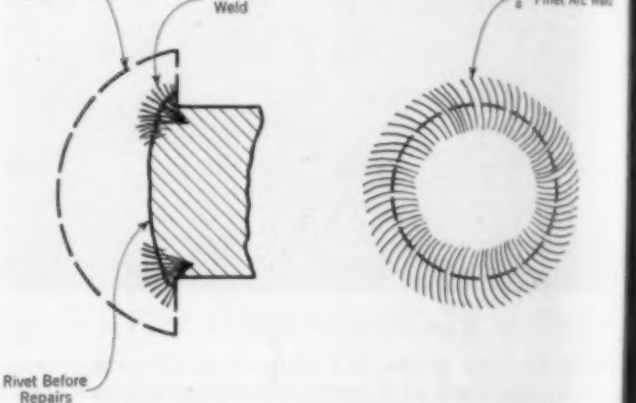


FIG. 3. METHOD OF RESTORING RIVET HEADS

getting new steel parts and the difficulty of obtaining second-hand parts needed, the arc-welding process is just about the only way in which minor yet essential repairs can be made.

This article is abstracted from a prize-winning paper in the recent competition of the James F. Lincoln Arc Welding Foundation of Cleveland, Ohio.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Comments on Engineering Terminology

DEAR SIR: I would like to comment on Mr. Sowers' article, "Load Required to Compress Concrete and Rock," in the August issue. Mr. Sowers starts out by referring to the term "compressive strength" when applied to concrete and rock as "loose." One might question whether the terminology he uses is any improvement.

For instance, in the title of his article, he uses the word compression, when it is pulverizing or crushing that he actually discusses. Any load will compress concrete or rock, but not every load will pulverize or crush. It is thought by the writer that when an engineer refers to the compressive strength of concrete, he means the resistance in pounds per square inch of the concrete to an external compressive force, as determined by the test of a standard 6 by 12-in. cylinder; or if he refers to the compressive stress of rock, he means the same thing as determined from the test of a standard A.S.T.M. compression specimen of rock or building stone. The term compressive stress, when determined by the standard method, is applicable to most uses of concrete and stone. That the specimen fails by diagonal shear (not diagonal tension) or by lateral

strain (which the author does not mention) is beside the point. The over-all result is a measure of the resistance to an external compressive force and as such is, at failure, the strength to resist compression.

The author seems to use the terms "true compressive strength" and "pure compressive strength" interchangeably, but does not define either term. Since neither term is defined in his article nor in any standard, and since "compressive strength" is defined (page 1009 A.S.T.M. Standards, 1942 part II), it would seem that the latter cannot be considered as loose when applied to the conditions where the load is distributed over the whole cross section.

Instead of using compressive strength as defined by the A.S.T.M., the author uses "cylinder crushing strength" and "cube crushing strength," thus introducing terminology for something that already has an accepted name. One definition of crushing implies reducing to dust or fine particles, which is one of the results of the conditions of testing that the author imposes, but is not the result obtained in a standard compression test.

It should be clear to engineers that the conditions of compression which the author has in mind are different from the usual and that the resulting stress at failure should not be called "compressive strength." It is not clear to the writer why, in the author's conditions of compression, the stress at failure should be called "pure" or "true" compressive strength, which terms he uses in part of his article. "True crushing strength," which he also uses, seems to fit the case better, but why is it necessary to employ the word "true?" And just what condition of lateral support will the author use to get relative results for his crushing strength? Upon the thickness of his specimen and the rigidity of his lateral support will depend the crushing strength he obtains.

F. N. MENEFEE, M. Am. Soc. C.E.
Professor, Engineering Mechanics,
University of Michigan

Ann Arbor, Mich.

Current Practice in Designing Drainage Structures

DEAR SIR: The article by F. William Greve on "Bridge and Culvert Flow Areas," in the August issue, is an interesting discussion of current practice in determining runoff for highway and railway drainage structures. The various methods and procedures described extend the range of discussion, however, from runoff to the completed design of such structures. When they are properly arranged and related, a definite rational basis for the design of drainage structures emerges.

In certain parts of the country it is not always economic to provide sufficient hydraulic capacity in drainage structures so that there will never be any overflow at any time or any damage resulting from it. The determination of what frequency of overflow and anticipated damage are acceptable is a matter of judgment, tempered by experience and the requirements of public policy. The evaluation of hydraulic factors is, however, subject to rational treatment.

In brief, this treatment consists in the determination of runoff for various frequencies, channel discharge for various stages, and characteristics of flow in the structure. The various methods and procedures described by Professor Greve relate to one or another of these determinations. No one of the methods is a solution of the complete problem, but several methods may be used as checks and aids in more accurate estimation of the three basic factors.

In the design or review of any given crossing, the essential relationships are stage frequency, stage discharge, and stage-net waterway opening. When hydrographs for extended periods are available, the state frequency curve may be estimated directly. When current meter readings have been made for a considerable range in stage, the stage-discharge ("rating") curve may also be obtained directly. Quite often it will be necessary to establish the rating by application of Manning's or Kutter's formula and, when the hydrograph is short or non-existent, to set up the stage-frequency curve by estimating runoff for various frequencies, and equating these values to the rating curve.

When the velocity of discharge is below the "critical," the velocity-head relation may be determined by the orifice formula, as stated by Professor Greve. In bridges, when the contraction is small, D'Aubisson's formula may be applied, in which the backwater is equal to the difference in the velocity head of approach and velocity head in the structure. Critical flow occurs when the velocity head is equal to one-half the average depth. The profile of the water surface in this case may be determined by the method described by Woodward and Posey in *The Hydraulics of Steady Flow in Open Channels*, published by John Wiley and Sons and by others.

Austin, Tex. ARNOLD STAUBACH, Assoc. M. Am. Soc. C.E.

Angles of Response for Earthfill

TO THE EDITOR: The article by Mr. Van Sant in the August number, on an earth-fill dam in New Mexico, contains certain statements that should not pass without comment. On page 368 Mr. Van Sant states: "When wet, sand has an angle of repose of 2.5 to 1 and clay of 3.5:1. A mixture of sand, clay and gravel, however, has an angle of repose of 2:1."

It is quite possible that the author meant the sand, clay, and gravel at the particular spot where the dam was built, although he does not so state. It is generally agreed today that different sands and clays possess different angles of repose and that it is no more proper to speak of the angle of repose of clay (meaning clay in general), or of sand for that matter, than it is to speak of the compressive strength of concrete. Just as the compressive strength of concrete varies according to proportioning, curing, and other factors, so does the angle at which a bank of sand or clay will stand vary with the particular material. When one speaks of the angle of repose of a mixture of clay or sand, it is analogous to speaking of the compressive strength of reinforced concrete without specifying the amount of reinforcement or its type. The relative amounts of sand and clay in the mixture will govern the properties thereof, just as the amount and distribution of steel influence the behavior of reinforced concrete.

The compilation of "authoritative" values for the angle of repose of various types of soil has led in the past to dangerous designs and failures on the one hand, or to uneconomical designs on the other. Realizing this fact, many present-day engineers attempt rather to establish the angle of internal friction and other physical properties of the types of soil that are available for a given project, so that designs may be in closer harmony with the actual properties of these available materials rather than assumed properties of hypothetical materials.

The writer believes that the general use of such values as are cited by Mr. Van Sant is unwarranted except in connection with preliminary estimates, and that such figures should be given only when they refer to specific types of clay or sand or other materials. If such statements as that just quoted appear frequently without further qualifications as to the scope of their applicability, there will be danger of indiscriminate and inappropriate use of the numerical values.

HAMILTON GRAY, Jun. Am. Soc. C.E.
Assistant Professor of Civil Engineering
New York University

New York, N.Y.

Herschel or Venturi?

TO THE EDITOR: In justice to Clemens Herschel, I feel I must pick up the gage cast down by Mr. J. C. Stevens in the August issue. His assumptions (*a*) that Venturi, in his many experiments on orifices, short tubes, and flaring tubes, "might have observed a relation between flow and pressure difference," and (*b*) that Herschel "must have recognized Venturi's priority of the principle involved or he would not have named his invention the Venturi Meter," cannot be supported by the known facts.

Here is what Herschel himself had to say in 1907 in a pamphlet entitled "The Venturi Water Meter and the First Twenty Years of Its Existence." He speaks of how he, as hydraulic engineer for the Holyoke (Mass.) Water Power Company, was "sorely troubled" by the large amount of unaccounted-for wash water used by the manufacturing corporations as supplied through 20 and 24-in. cast-iron pipes. "Many a time," he says, "did the Hydraulic Engineer

stand beside such a pipe and exert himself to invent how to force these pipes to reveal the secret of their hidden action. In course of time, between 1882 and 1886, these endeavors resulted in a determination at the first opportunity to try how an apparatus like this would work: place an orifice at some point in the pipe, circular and in the form of an ajutage, from choice, and then place an expanding cone or ajutage, downstream from the orifice, in order that the loss of head occasioned by the first orifice may be regained, and no material loss of head be occasioned by the whole apparatus; all of this superimposed on the existing hydraulic gradient....

BIRTHPLACE OF THE VENTURI METER, HOLYOKE, MASS.

"In 1886, the Hydraulic Engineer received confirmation of his ideas and notions from an account of Bourdon's Anemometer used in France to measure the velocity of currents of air in mines; and proceeded to design his water meter, then named the Venturi Meter, out of respect for the 'Citizen J. B. Venturi' who, 'An VI. (1797)' published his 'Recherches Experimentales sur le Principe de la Communication Laterale du Mouvement dans les Fluides.' Venturi's experiments were made in Modena, about 1791, and he had observed that when fluids or gases discharge through an expanding nozzle or ajutage, that a sucking action is exercised at the small diameter, diminishing as the diameter increases. But Venturi made or suggested no use to be made of this property, and with him it was merely a curious feature in the working of his apparatus. Nor did he correctly explain any of the properties observed (note this especially—C. G. R.). The experiments detailed in Francis' 'Lowell Hydraulic Experiments' had determined the shape of expanding ajutage which would give the maximum discharge under a given head; and that is the same thing as a form that will cause the least loss of head with a given discharge, which was what the Hydraulic Engineer then wanted. And the rest was easily supplied."

Herschel, in his original paper before the Society in 1887, mentioned the Bourdon Anemometer as "founded upon the property of a Venturi Tube to exercise a sucking action through holes bored into its narrowest section," and Venturi's observation of this phenomenon.

While it is gratifying to learn that Mr. Herschel will be recognized in the next edition of "Hydraulic Models," the form proposed by Mr. Stevens is both inadequate and incorrect. Venturi was a brilliant engineer but his experiments did not "disclose the principle of the flow meter invented by Clemens Herschel"; rather, to Herschel should be given full credit for the conception and the invention.

Illustrated herewith is a still-standing building of the Holyoke Water Power Company. Underneath floor boards one can still see the famous Holyoke Testing Flume which Herschel built for measuring the efficiency of hydraulic turbines so they could be used as meters, and which he employed in his experiments on the first two Venturi Tubes.

CHARLES G. RICHARDSON, M. Am. Soc. C.E.

Providence, R.I.

TO THE EDITOR: Mr. Richardson's statement that my "assumptions . . . cannot be supported by the known facts" appears to be discredited by the statement that he himself quotes from Herschel's own pamphlet. If a constriction is put in a conduit carrying a fluid, a drop in pressure results which, by Mr. Herschel's ingenuity, has become an index of flow. Today we speak of this phenomenon as a drop in pressure, but Venturi in 1791 called it a "sucking action." Herein lies the fundamental principle of the venturi meter, which Clemens Herschel recognized and elaborated upon.

Of course, it took him a long time and much study and research to actually put the principle to practical use, but when it was done he was liberal-minded enough to recognize what Venturi had remarked upon and very magnanimously named his invention the venturi meter. It seems to the writer, therefore, that the proposed amendment to the statement in Manual 25 is in fair accord with the historical facts.

J. C. STEVENS, M. Am. Soc. C.E.

Portland, Ore.

Forum on Professional Relations

CONDUCTED COLUMN OF HYPOTHETICAL QUESTIONS WITH ANSWERS BY DR. MEAD

For over a year now Dr. Mead has been answering questions on engineering ethics in these columns. Herewith he gives his views on Question No. 13, which was announced in the August issue. The question reads: "A friend of Engineer 'A,' out of work and in need of employment, applied for a job in 'B's' office, for which he was very poorly fitted. However, because of his fine personality he was being earnestly considered for the work. The job involved considerable responsibility and the young engineer lacking this experience would, in 'A's' opinion, need time to work successfully into the position. The applicant referred to 'A,' and the company has asked 'A' to give his opinion of the man and his ability for the position for which he has applied. Should 'A,' with his knowledge of this applicant, advise the company concerning his real opinion of the man's qualifications for the job, or should he so word his letter as to retain the friendship of the young engineer and let the company find for itself from experience the true worth of the young man seeking employment?"

The writer believes that the greatest asset of any engineer is dependability, the most important factor of which is absolute truthfulness. There is no valid reason why an engineer should lie for himself; neither should he falsify for a friend. If he knows that his friend has not the experience necessary for the successful handling of the job in view but believes that he can quickly acquire the experience, let him say so in plain terms. If the young man's personality is attractive, the employer will probably take the chance of employing him and will realize the necessity of advising, assisting, and training him until he has gained sufficient experience to qualify him fully for the job.

On the other hand, should the young man be employed with the understanding that he is fully qualified, the employer will expect more from him than he should. Furthermore, he is apt to make some slight mistake which should not be made by a qualified man, and through such error may lose the job that otherwise he might retain.

Despite the apparent advantages of fraud and deceit, honesty is still the best policy.

DANIEL W. MEAD, Past-President and Hon. M. Am. Soc. C.E.

Madison, Wis.

Other problems of professional relations will be treated by Dr. Mead each month. Next in sequence for study and written discussion by members until November 5, with answers in the December number, will be the following:

QUESTION NO. 15: *An engineer makes plans and writes specifications for an installation that is somewhat novel and unique. Is he justified in using essentially these same plans a second time if no stipulation to the contrary has been made by the client for whom the first work was done and if no data supplied by the first client are used?*

SOCIETY AFFAIRS

Official and Semi-Official

War and Postwar Engineering Conference, Atlanta

Georgia Section Issues Hearty Invitation to Enjoy Its Excellent Program, October 12–14, 1943

ENGINEERS of the South are critically conscious of the impact of war. All around them are tremendous military establishments serving all branches of the armed forces, as well as mammoth manufacturing plants, to say nothing of the great normal agricultural and business services supplying food and clothing. This intense interest is reflected in the plans for the meeting of the Georgia Section in Atlanta, October 12–14. In keeping with its chief topic, the meeting has been fittingly named "War and Postwar Engineering Conference."

Strictly speaking, this is the fall meeting of the local group. But actually it has a wider connotation, in that many visitors from farther away will be there on Society business; and in that all Society members are especially invited, and urged, to participate in the worthwhile program. The fact that there is no official Society fall meeting makes the Atlanta conference the nearest thing to a Society gathering in October.

ACCOMPANYING FEATURES PLANNED

Other features will lend an official coloring. The Board of Direction is scheduling its regular meeting just preceding, supplemented by various committee meetings. In addition, one whole day will be devoted to a Local Sections Conference, with representation expected from 17 states. This will be on Tuesday, the 12th. The following day the Georgia Section takes over in earnest, devoting one and one-half days to the exchange of technical views, based on a finely arranged program, and finally comes a half-day inspection trip to complete the conference late on Thursday, the 14th.

So much for the general outline. The national scope of Society activities will be emphasized by the presence of members of the Board of Direction from widely scattered points all over the country, and by an address from the President. The regional aspects of the meeting will center in the Local Section Conference, to be attended by delegates from the Great Lakes and nearer points. Of course the bulk of the interest in the meeting will come from members in Georgia and nearby states.

For such a meeting Atlanta makes an ideal spot. It is the metropolis of the Southeast and is important for other reasons than size. As a railway center it will make traveling convenient; as a historic spot it offers untold attractions; and as a military and engineering headquarters it is ideal for a wartime gathering. It should not be forgotten, too, that the middle of October with its autumn foliage is a delightful time of year in a region noted for its natural beauty.

THRESHING OUT LOCAL SECTION PROBLEMS

Regular meetings of the Board are scheduled for Monday and Tuesday. Somewhat overlapping in time, but not in function, will be the Local Section Conference. Society matters and other subjects of interest to Local Sections will occupy its attention all day Tuesday. Representatives from 31 Local Sections have been invited to attend, these being Sections from the eastern part of the United States, other Sections having been represented at similar conferences held this year at the spring meeting of the Texas Section in Dallas in April, and at the Annual Convention in Los Angeles in July.

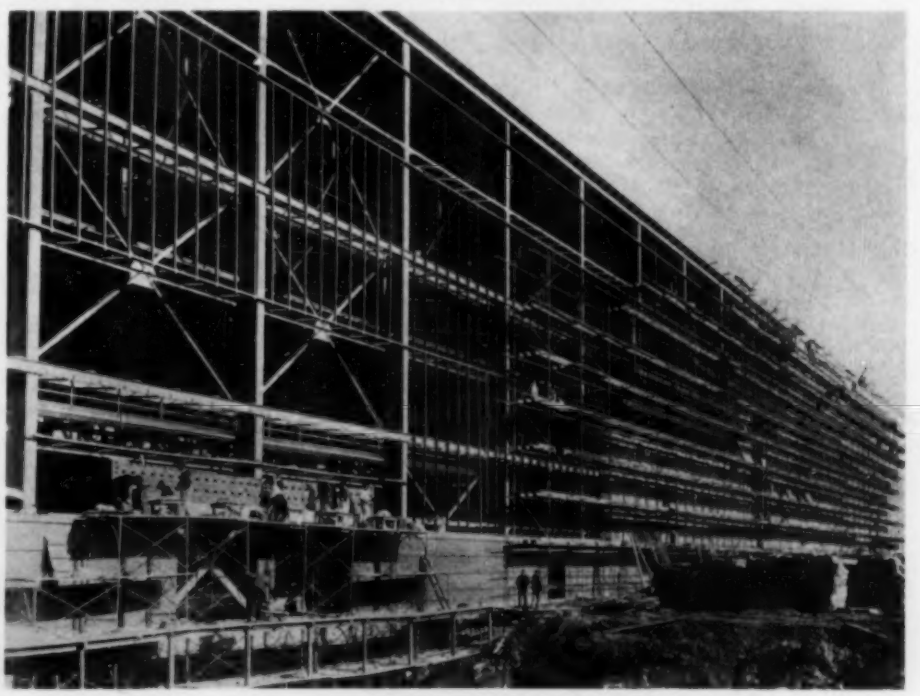
These Local Section Conferences are informal, round-table discussions, at which representatives have opportunity to bring up any matter of interest, but it is customary to prepare an agenda based upon suggestions received from invited delegates. At the Atlanta Conference, the following subjects will appear on the agenda:

Employer-Employee Relationships
Engineers' Part in Postwar Planning
Encouragement of Participation in Local Section Activities
Effect of War on Local Section and Student Chapter Activities
Junior Forums—Their Programs and Relationship to Local Sections
Engineer's Part in Public Life
Participation of the Local Section in Civic Affairs

The conference is open to all members of the Society, whether or not they are attending as official representatives of Local Sections. It is hoped that many members of the Georgia Section and others who may attend the meeting will avail themselves of the opportunity to be present at and participate in the discussions.

SOME ATTRACTIONS IN DETAIL

All functions except the inspection trip will be held in the spacious Atlanta Biltmore Hotel. Following registration early on Wednesday morning, October 13, the conference itself will open at 10 o'clock. Proper devotional and social formalities are first on the order of business. These will be followed by a few words from the President of the Society and then the technical discussions will begin. The program of the meeting, as so ably arranged by the local officers, is as follows:



MARIETTA AIRCRAFT ASSEMBLY PLANT
Exterior View During a Late Stage of Construction

SKYLINE OF DOWNTOWN ATLANTA

Wednesday, October 13, 1943

9:00 a.m. **Registration** (no fee) Foyer Georgian Ballroom, Biltmore Hotel

10:00 a.m. **Conference called to order by** PAUL WEIR, *President, Georgia Section, Am. Soc. C.E., Assistant General Manager, Atlanta Water Works,* Atlanta
Invocation by DR. ROBERT W. BURNS, *Pastor Peachtree Christian Church of Atlanta*
Address of Welcome by HIS HONOR WILLIAM B. HARTSFIELD, *Mayor of the City of Atlanta*
Response by J. HOUSTOUN HOHNSTON, *Consulting Engineer and Past Director, Am. Soc. C.E.*
"Work of the Society," by EZRA B. WHITMAN, *President Am. Soc. C.E.*
"Recovery Will Not Wait for Peace," by FREDERICK H. MCDONALD, *Consulting Industrial Engineer,* Charleston, S.C.
Open discussion

12:30 p.m. **Luncheon,** Empire Room, $2.00 each
MAJ. WALTER S. MCDONALD, *Commanding Officer, Atlanta Officer Procurement District, 4th Service Command, U.S. Army, Atlanta, Presiding*
"Military Engineering Problems," by COL. FRANK L. SEYMOUR, *Chief, Repair and Utility Branch, 4th Service Command, U.S. Engineers, South Atlanta Division,* Atlanta, and
BRIG. GEN. JOHN S. BRAGDON, *Division Engineer and Director of Real Estate, Repair and Utilities, U.S. Engineers, South Atlantic Division, 4th Service Command,* Atlanta

2:00 p.m. **Georgian Ballroom**
"Postwar Transportation Problems," a Symposium
PROF. CHARLES BLANEY BREED, *Head, Department of Civil and Sanitary Engineering, Massachusetts Institute of Technology, and Director, American Society of Civil Engineers*
"Air," by CHARLES I. STANTON, *Director, Civil Aeronautics Administration,* Washington, D.C.
"Railway," by ROBERT S. HENRY, *Assistant to the President, Association of American Railroads,* Washington, D.C.
"Highway," by GUY KELCEY, *Consulting Transportation Engineer*
Open discussion

7:00 p.m. **Dinner,** Pompeian Room, $3.00, Informal Dress
JAMES C. PRATHER, *Vice-President Georgia Section and Superintendent Rich's Inc., Atlanta, Presiding*
"Postwar Economics"
MALCOLM H. BRYAN, *Vice-President, Federal Reserve Bank, 6th District,* Atlanta
FRANK H. NEELY, *President, Federal Reserve Bank, 6th District,* Atlanta

Thursday, October 14, 1943

9:30 a.m. **Georgian Ballroom,** Biltmore Hotel
"Highlights on Construction of the Marietta Aircraft Assembly Plant (Bell Bomber Plant)," by L. W. ROBERT, JR., *President, Robert and Company Associates,* Atlanta
"Design and Construction Problems of the Marietta Aircraft Assembly Plant (Bell Bomber Plant)," by RAYMOND W. STUCK, *Chief Engineer, Engineering Division, U.S. Engineers, South Atlantic Division,* Atlanta
Open discussion

11:00 a.m. **Leave Biltmore Hotel by special trolley train for Bell Bomber Plant inspection trip**
Round trip tickets 55 cents each; members and men guests only, properly identified

12:30 p.m. **Luncheon** served on reservation by courtesy, Robert and Company Associates
Inspection Tour Hosts: U.S. Army, Bell Aircraft Corporation, and Robert and Company

LADIES PROGRAM

Wednesday, October 13, 1943

12:00 Noon **Luncheon Party,** Magnolia Room, Rich's Inc.
Meet at Ladies Lounge, main lobby, Biltmore Hotel
Shopping Tour, Rich's, Inc.

3:30 p.m. **Fashion Show and Tea,** Magnolia Room, Rich's Inc.

7:00 p.m. **Dinner,** Pompeian Room, Biltmore Hotel, Informal Dress

Thursday, October 14, 1943

12:00 Noon **Luncheon,** Biltmore Hotel
Meet at Ladies Lounge, main lobby, Biltmore Hotel

2:00 p.m. **Trip** to Atlanta's beautiful Grant Park, home of the historic Cyclorama Memorial

FINAL INSPECTION TRIP

Delightful as well as appropriate will be the inspection trip to the Marietta Aircraft Assembly Plant, which will serve as a finale for the meeting. After a ride of a few miles out of Atlanta and a luncheon at the plant, opportunity will be given to see one of the largest and most recent installations of this type. The unique transportation and construction features of the plant will be explained by those who have been directly responsible, that is, the Army officers, aircraft officials, and consulting engineers. This fine trip dovetails perfectly into the program of the meeting as a whole. It is to be noted that citizenship identification is required and that unfortunately the ladies are not permitted to participate. However, they will have a fine trip of their own.

Events for the ladies have been carefully planned to give them entertainment, nourishment, and sociability. Any who have not previously visited Atlanta have a novel experience in store; and those who have been there previously will need no urging to return. The appeal of this meeting is frankly built around the opportunity of aiding the war effort through interchange of engineering ideas and experiences. Supplementary to this all-important thought will be the contacts with a loyal Society group in very pleasant surroundings. No Society member who finds himself within ready reach of Atlanta should fail to attend this meeting of the Georgia Section. A warm southern welcome awaits men and women alike.

LOOKING ACROSS CAMPUS OF GEORGIA SCHOOL OF TECHNOLOGY TOWARD BUSINESS SECTION OF ATLANTA

Engineers in Collective Bargaining

Union Objects to Articles in "Civil Engineering" re Experience at Sunflower Ordnance Plant

AS requested by the International Federation of Technical Engineers, Architects and Draftsmen's Union (A. F. L.), publication is here made of (1) letter of criticism from J. Lawrence Raimist, International Vice-President of the Union, dated September 14; (2) letter of reply from Secretary Seabury under date of September 17; and (3) excerpt from the official "Report of Panel to Regional War Labor Board" in question.

INTERNATIONAL FEDERATION OF TECHNICAL ENGINEERS, ARCHITECTS & DRAFTSMEN'S UNIONS

15 East 40th Street
New York City-16, N.Y.
September 14, 1943

Re: National War Labor Board Case No. 111-218-D in the Matter of:
William S. Lozier, Inc.—Broderick & Gordon, Sunflower Ordnance Plant near de Soto, Kansas
and
International Federation of Technical Engineers, Architects and Draftsmen's Union, Local 30 (AFL)
Concerning which articles appeared in the Civil Engineering Monthly Publication of July, August and September.

Mr. Howard Peckworth, Secretary
American Society of Engineers
29 East 39th Street
New York City, N.Y.

DEAR SIR:

The writer has followed the various news items which have appeared in the Civil Engineering Magazine published by your Society.

He is amazed at the number of mis-statements and omissions of facts. Instead of writing so much about it as you did in your various issues, don't you think it would have been much simpler to publish the attached Exhibit "A," which is a copy of the War Labor Board Panel's recommendation to the War Labor Board in Kansas City and which shows the true facts as presented at the War Labor Board, including the restriction which the Society tried to place on men, namely that employees who are earning $65.00 or more should be excluded from Local 30 of our International.

In your own July article you have admitted that you are opposed to paying overtime to employees after eight hours per day and after forty hours per week. In your article you also refer to pre-professional employees—what are pre-professional employees—don't you mean rather anti-union employees. Why have you omitted the statement that of all the committee that represented the so-called professional group on the Sunflower Ordnance Project construction job, Professor McNown was the only graduate engineer, that the other two members of the committee—namely, Mr. J. C. Donaldson is neither a graduate engineer nor a licensed professional engineer and that Mr. W. S. Ruggles is not a graduate engineer but is a licensed professional engineer. Also, the fact that Mr. Ruggles is an employer, or rather has been an employer until he took his job. These are a few of the facts which we would like to see published in your magazine and which facts are the correct statements of what transpired.

The writer hopes that after receiving this letter, that you will publish all of these facts either in your Society news column where you published the other articles, or perhaps you would care to publish this letter, together with the attached exhibit, and please note that the attached exhibit is the unanimous recommendation of the entire panel to the War Labor Board, sitting in this case, thus the public member, the industry member and the labor member were all in agreement.

It may also be of interest to you that the Panel's report was in the hands of all parties before the end of the first week of July.

Very truly yours,
(Signed) J. LAWRENCE RAIMIST,
International Vice President

September 17, 1943

MR. J. LAWRENCE RAIMIST
International Vice President
International Federation of Technical Engineers, Architects & Draftsmen's Unions
15 East 40th Street
New York 16, N.Y.

DEAR SIR:

Reference is made to your letter of September 14th, addressed to Mr. Howard F. Peckworth, Assistant to the Secretary of this Society, which, in his absence, I acknowledge.

As Mr. Peckworth is now, and for a period of perhaps three weeks more will be, travelling on the Pacific Coast, it appears impracticable to comment now on the "number of mis-statements and omissions of facts" which you state to be in his articles*.

That your letter, as requested, may have prompt attention, it will be published in the October 1st issue of "Civil Engineering," together with this, my acknowledgment of its receipt.

Instead of publishing only that portion of the Panel's report quoted in your Exhibit "A," the Exhibit will be extended to include also the three preceding paragraphs of the Panel's report, thus providing for, I believe, a more complete understanding of the situation.

Also, that Mr. Peckworth's article in the July issue of "Civil Engineering" may be understood as he intended it to be understood, it seems appropriate that the last few words of that article, reading as follows, be repeated:—"As this article goes to press, the WLB Panel in Kansas City has not handed down its decision."

Very truly yours,
GEORGE T. SEABURY
Secretary

* "Civil Engineering" July 1st pages 337–338, August 1st page 394, and September 1st page 443.

Quotation from "Report of Panel to Regional War Labor Board" re Sunflower Ordnance Plant Dispute

THE UNIT

During the course of the hearing, for the purpose of determining who was the representative of the non-manual technical employees of the Company, the Panel requested, for its information and in its behalf, that the Disputes Division hold an election. Both the Company and the Union agreed (pp. 181–3, Vol. 1, Transcript of Testimony) that the unit should be comprised of the following: All Technical Engineers and Architectural Employees, more specifically described as Technical Engineers, Architects, Designers, Draftsmen, Surveyors, Technical Inspectors, Blueprint and Photostatic Machine Operators and Assistants and persons holding such positions regardless of assigned titles or classifications.

There was specifically excluded from the unit: The Chief Engineers, Assistant Chief Engineers, Project or Unit Chiefs as re-

vealed by the Charts and records of the Company or their assistants or any such person holding such position regardless of the assigned title or classification. Also any senior assistant engineers who appear on the charts and records of the Company as Unit or Project Chiefs or their assistants.

The Panel recommends that the unit as agreed upon as heretofore set out and the exclusions therefrom as agreed upon, be adopted by the Regional War Labor Board in its Directive.

LOCAL NO. 30 REPRESENTS THE UNIT

The election under the supervision of the Disputes Division was held on May 18, 1943, at De Soto, Kansas. Three hundred sixty-seven (367) employees cast their vote for representation by Local No. 30 of the International Federation of Technical Engineers, Architects and Draftsmen's Union: Seventy-two (72) cast their vote against said representation by said Local.

Subsequent to the date of said election and on May 21, 1943, there appeared before the Panel, William C. McNown, W. S. Ruggles, Jr., and Jack C. Donaldson, the first two employed as Senior Assistant Engineers on the job, and the latter as an Assistant Engineer, as individuals, and requested that the professional engineers employed by the Company be not included for collective bargaining purposes in Local No. 30. Because these three men appeared individually and not in behalf of an organization, the Panel refused to admit their testimony.

On June 3, 1943, these three gentlemen returned before the Panel accompanied by Harold M. Noble, Esq., an attorney, and Mr. Howard F. Peckworth, Assistant to the Secretary of the American Society of Civil Engineers. The three engineers represented themselves to be the bargaining committee of an organization known as the Professional Engineers and Architects, employed at Sunflower Ordnance Works. They endeavored to file an intervening petition on behalf of this group at this time, which request was refused. A petition purportedly signed by 108 employees, objecting to their inclusion in Local No. 30, was presented and filed with the Panel. This new alleged bargaining agent held its first meeting of organization on May 27, 1943, some nine (9) days after the election held on behalf of the Panel. It is briefly the contention of this group and its attorney and Mr. Peckworth of the American Society of Civil Engineers, that the professional engineers employed at the Sunflower Ordnance Plant who meet the qualifications of the Kansas Engineers Society, being four years college education and two years practical experience or six years professional engineering and architectural experience, and who are earning $65.00 a week or more, should be excluded from Local No. 30.

The Union contends that this is an arbitrary, harsh, improper and erroneous classification. That in its membership it has both professional and sub-professional groups and that to set one off against another was unfair and impractical.

The Panel heard the evidence and arguments of the professional engineers as part of the Company's case.

The Panel recommends that no distinction be made between professional or sub-professional engineers in the definition of the unit as eventually determined by the Regional War Labor Board. By virtue of the stipulation heretofore referred to, both the Company and Union agreed upon a unit without any such distinction as is now contended for by the professional engineers' group. That the proposed test for exclusion offered by the alleged professional group is inaccurate and unreasonable.

The Panel further recommends that the Regional War Labor Board issue a directive ordering the Company to recognize Local No. 30 as the Collective Bargaining Agent for the non-manual technical employees of the Company as heretofore described.

A Warning

INFORMATION has reached the Society that the engineering profession is being circularized by a concern of "Associates" who describe themselves as "Public Relations and Sales Consultants to the Engineering Profession," with office address on Madison Avenue in New York City. If this concern has any large organization or staff, it is not located at this Madison Avenue address. Its equipment and facilities are not known to the New York officers of the American Society of Civil Engineers, and it is not listed under its business title in the New York Telephone Directory.

Americas Arrange to Exchange Engineering Knowledge

ARRANGEMENTS have been completed for greater sharing of up-to-date engineering knowledge among the Americas, through translation and exchange of technical papers. Under direction of the Division of Engineering and Industrial Research of the U.S. National Academy of Sciences, important scientific articles by authorities in the United States will be selected for translation into Spanish and Portuguese. They then will be distributed to individuals or published in engineering journals in the other Americas. Articles furnished by engineering societies in the other republics will be translated into English and prepared for distribution in a similar manner in the United States. This information comes from the Office of Inter-American Affairs, Washington, D.C.

Collaborating with the National Academy of Sciences in this work are the Joint Committee on Inter-American Engineering Cooperation and the Inter-American Development Commission. The Joint Committee is made up of representatives of leading engineering societies: The American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, and American Institute of Chemical Engineers, having a total membership of around 70,000.

In addition to exchange of papers, the joint committee's programs include promotion of professional and social intercourse; collaboration on technical problems related to industries and public works and development of natural resources; exchange of individual and collective visits; and participation in international congresses. The joint committee has received from the other Americas many favorable responses to the plans about scientific papers. The joint committee will obtain from the engineering societies technical articles by their members. Digests will then be sent to societies in the other Americas, so that they may indicate the articles in which there is the most interest. The Chairman of the joint committee is Philip W. Henry, M. Am. Soc. C.E. Its secretary is Dr. Arthur M. Green, Dean Emeritus of the School of Engineering of Princeton University.

Use of Consultants on Part of Government Agencies Recommended by Board of Direction

DURING the recent tremendous construction program for war preparation, services of practicing and consulting engineers, as firms, were in great demand to perform record-breaking engineering feats. From time to time, however, efforts have arisen in the form of legislative enactments or legal suits to restrain or limit their use. The Board of Direction has been much concerned with this development, which it conceived to be contrary to the best interest of the profession. It therefore expressed its approval of the use of consultants in concrete form. Following is the authorized statement of the Board's position:

"WHEREAS, It has been brought to the attention of the Board of Direction of the American Society of Civil Engineers that action has been proposed at various times for the purpose of preventing the employment by governmental bodies of private practicing engineers, architects, or firms of engineers or architects for the preparation of reports, plans, specifications, and contracts, or for the supervision of the construction of public works; therefore be it

"*Resolved*, That the Board of Direction of the American Society of Civil Engineers expresses its opinion that such proposals are not in the public interest, for the following reasons:

"1. The practice of engaging private practitioners, both as consultants and for complete engineering and architectural services, is one of long standing that has brought immeasurable benefits to both the large governmental units which maintain engineering and architectural staffs and the smaller agencies whose normal engineering and architectural needs do not require the regular employment of permanent engineering or architectural staffs of the size or skill adequate for such work.

"2. The practice has made available the services of engineering and architectural firms that have accumulated special qualifications in their respective fields and have developed in themselves and their

staffs aptitudes of exceptional value. Loss of such skills would be detrimental to the advancement of engineering and architecture.

"3. Forced abandonment or extensive curtailment of this practice would seriously handicap the smaller municipalities by depriving them of the services of engineers and architects on whom they now depend for professional work beyond the capacity of their own limited staffs.

"4. Availability of such specialists makes it possible for even large governmental units to engage them to carry peak loads, thus making unnecessary temporary expansion of regularly employed forces, with the difficulties involved in assembling an organization to be dissolved upon the completion of the undertaking.

"5. On the other hand, governmental agencies with permanent engineering and architectural forces, should utilize those staffs to do the normal volume of their engineering or architectural work. Only by providing those staffs with stimulating work can governmental agencies attract and hold the services of men of high ability.

"6. Any prohibition of the employment of private practicing engineers and architects, or firms, would keep public officials from exercising discretion in deciding whether it is in the best interests of the public to employ such specialists, or to build up a governmental staff."

Possible Delay in October PROCEEDINGS

WAR CONDITIONS inevitably create difficulties in the printing of Society publications. Heretofore we have been very fortunate in that so few delays have been experienced. Because of the fine record it is necessary to warn members in advance that there may be some delay in the issuing of the October 1943 PROCEEDINGS.

It will be recalled that this number includes two parts—Part I, the regular October PROCEEDINGS, and Part II, the yearly "Transactions Number." It is the latter volume which is causing some difficulty this year. An additional amount of sewing and binding has crowded the printing facilities so that there may be a few days' delay in the final issuing of this particular volume.

Members should be forewarned that the regular October PROCEEDINGS, Parts I and II together, may be a few days late in arriving. Those members who have ordered the leather or cloth binding, will receive their TRANSACTIONS later, and their regular Part I number of PROCEEDINGS will go out as usual on October 15. For those members, comprising about half of the total, there will therefore be no delay.

Advisory Committee on Investigation of Long-Span Suspension Bridges

Progress Report on Organization and Work to Date, as Presented Before the Structural Division at the Society's Los Angeles Convention, July 28, 1943

THE FAILURE of the Tacoma Narrows Bridge on November 7, 1940, brought forcibly to the attention of engineers concerned with the design of long-span suspension bridges the need for a comprehensive investigation of the design of such structures, particularly with respect to the effect of aerodynamic forces.

The possibility of organizing such an investigation was discussed by a representative group of engineers concerned with the problem at a meeting held in New York City on September 18, 1941. At this meeting the following resolution was adopted and transmitted to Thomas H. MacDonald, Commissioner of Public Roads:

"WHEREAS, It appears that the investigation of the safety of suspension bridges and their adequate design under aerodynamic forces is of such national importance that it should be initiated and carried out by the proper Federal authority; the undersigned respectfully request that such a program of investigation be initiated and carried out by the Public Roads Administration."

Subsequently, Mr. MacDonald indicated that the Public Roads Administration would be willing to initiate the undertaking, at least to the extent of determining the possibility of outlining a feasible and acceptable program of research.

It was decided that an undertaking of this magnitude should be carried on under the general direction of a group of competent engineers representing various organizations having an interest in the problems to be studied. Such a group was organized by the Public Roads Administration and is now active. It is known as the Advisory Committee on the Investigation of Long-Span Suspension Bridges and its function is to prepare the program of research, to assume general direction and supervision of the investigational work that is undertaken, and to approve reports of this work prior to their release for publication.

The Advisory Committee, of which E. F. Kelley is chairman, is composed of 27 members. A list of the members and the organizations which they represent is given below:

Agricultural and Mechanical College of Texas
- Dr. A. A. Jakkula, M. Am. Soc. C.E., Professor of Structural Engineering

American Association of State Highway Officials
- Raymond Archibald, M. Am. Soc. C.E., Chairman, Committee on Bridges and Structures
- C. B. McCullough, M. Am. Soc. C.E., Assistant Chief Engineer, Oregon State Highway Commission

American Institute of Steel Construction
- F. H. Frankland, M. Am. Soc. C.E., Director of Engineering
- C. F. Goodrich, M. Am. Soc. C.E., Chief Engineer, American Bridge Company
- Jonathan Jones, M. Am. Soc. C.E., Chief Engineer, Fabricated Steel Construction, Bethlehem Steel Company

American Society of Civil Engineers
- Russell G. Cone, M. Am. Soc. C.E., Assistant Chief Engineer, Silas Mason Company
- Shortridge Hardesty, M. Am. Soc. C.E., Consulting Engineer
- Charles M. Spofford, M. Am. Soc. C.E., Professor of Civil Engineering, Emeritus, Massachusetts Institute of Technology, and Consulting Engineer

California Institute of Technology
- Prof. Theodor von Karman, M. Am. Soc. C.E., Director, Daniel Guggenheim Aeronautical Laboratories

Engineering Institute of Canada
- P. L. Pratley, M. Am. Soc. C.E., Consulting Engineer

Golden Gate Bridge and Highway District
- L. H. Nishkian, M. Am. Soc. C.E., Consulting Engineer

Highway Research Board
- R. W. Crum, M. Am. Soc. C.E., Director

John A. Roebling's Sons Company
- Charles C. Sunderland, Chief Engineer, Bridge Department

National Bureau of Standards
- Dr. H. L. Dryden, Chief, Division of Mechanics and Sound

Mackinac Straits Bridge Authority
- Frank M. Masters, M. Am. Soc. C.E., Consulting Engineer

Port of New York Authority
- O. H. Ammann, M. Am. Soc. C.E., Director of Engineering

Public Roads Administration
- O. L. Grover, Principal Highway Bridge Engineer
- E. F. Kelley, Chief, Division of Tests
- R. B. McMinn, Highway Bridge Engineer, District 1
- Leon S. Moisseiff, M. Am. Soc. C.E., Research Consultant [deceased]

Princeton University
- Elmer K. Timby, Assoc. M. Am. Soc. C.E., Associate Professor of Civil Engineering

San Francisco–Oakland Bay Bridge Division, California Department of Public Works
- C. H. Purcell, Assoc. M. Am. Soc. C.E., Director of Public Works

Triborough Bridge Authority
- Emil H. Praeger, M. Am. Soc. C.E., Chief Engineer, Madigan-Hyland

Washington Toll Bridge Authority
- Charles E. Andrew, M. Am. Soc. C.E., Principal Consulting Engineer
- Glenn B. Woodruff, M. Am. Soc. C.E., Consulting Engineer

Yale University

Hardy Cross, M. Am. Soc. C.E., Professor of Civil Engineering

The Advisory Committee held its organization meeting at St. Louis, Mo., on September 23 and 24, 1942, and appointed five working committees as follows: Executive Committee, Committee on Field Observations, Committee on Model Studies, Committee on Interpretation and Analysis, and Committee on Publications.

The Advisory Committee met again in New York City on January 19, 1943, and in May 1943 it held three meetings on the Pacific Coast. The first of these meetings was held at Seattle to observe the tests of models of the Tacoma Narrows Bridge that are being made for the Washington Toll Bridge Authority at the University of Washington under the direction of Prof. F. B. Farquharson, Assoc. M. Am. Soc. C.E. The second meeting was held in San Francisco to make an inspection of the Golden Gate Bridge and the San Francisco–Oakland Bay Bridge. The third meeting was held at the California Institute of Technology at Pasadena to observe the model studies that are being made there under the direction of Dr. Theodor von Karman for the Washington Toll Bridge Authority.

Of the working committees of the Advisory Committee, the Committee on Model Studies, under the chairmanship of O. H. Ammann, has been the most active up to the present time. The committee has formulated a comprehensive program of model tests of long-span suspension bridges subjected to the action of aerodynamic forces, designed to answer the more important questions regarding adequate and economical design. Certain preliminary tests are now under way at the University of Washington in connection with the program of the Washington Toll Bridge Authority, and it is expected that other preliminary tests will be instituted elsewhere in the near future.

In connection with the work of the Advisory Committee, the Public Roads Administration is cooperating with the Washington Toll Bridge Authority in its study of the effect of aerodynamic forces on models of the original Tacoma Narrows Bridge and of the new design for this structure. Certain tests of primary interest to the Advisory Committee have been added to the original program of the Washington Toll Bridge Authority. This work is being done at the University of Washington and at the California Institute of Technology.

The Public Roads Administration is also cooperating with the American Institute of Steel Construction in financing theoretical studies that are of importance in connection with the work of the Committee on Model Studies and the Committee on Interpretation and Analysis, the latter committee being under the chairmanship of Leon S. Moisseiff [deceased September 3, 1943].

In addition, there is now under consideration possible cooperation with various bridge owners to provide for measurements of the movements of existing suspension bridges.

In view of the complexity of the problem and the relatively short time during which the project has been active, the Advisory Committee is of the opinion that excellent progress has been made. However, the committee is not prepared at this time to present more than this brief report of progress.

Engineering Organizations Give Approval to Amended Model Law

THE Model Law for the Registration of Professional Engineers and Land Surveyors was amended at a conference of representatives of ten national engineering societies held at Society Headquarters on May 24, 1943, as reported in the July issue of CIVIL ENGINEERING, page 338.

Four of the collaborating societies have now "approved and endorsed" the Model Law as amended. The American Society of Civil Engineers was the first to give this approval, at the meeting of its Board of Direction in July 1943. The second and third organizations to give it were the National Society of Professional Engineers and the American Institute of Consulting Engineers. It is now officially announced that the board of directors of the American Association of Engineer . has also "approved and endorsed" the amended Law, making this the fourth organization to do so.

The new paragraphs added to the Model Law were given in the item in CIVIL ENGINEERING previously referred to. Apply to Society Headquarters for copies of the law as amended and awaiting endorsement by other engineering societies.

Donald D. King Leaves Publications Staff for Service with Army

As the October issue of CIVIL ENGINEERING goes to press, Donald D. King is taking up his duties in Washington, where he will serve the U.S. Army for the duration. Mr. King, who has been a first lieutenant in the Corps of Engineers, New York State Guard, is to join the staff of Brig. Gen. S. C. Godfrey, M. Am. Soc. C.E., Corps of Engineers, U.S. Army. His duties will include technical editorship of the publication, "Engineer Notes," a periodical for the Air Force Engineers.

DONALD D. KING, Assoc. M. Am. Soc. C.E.

Thus Mr. King follows four other members of the Society's staff at one time or another in publication work (Messrs. Beam, Jessup, Barnes, and Johnstone) into military service. He interrupts 13 years on Society publications, where he has managed the art and production work. His tenure with the Society thus goes back to the summer of 1930, when CIVIL ENGINEERING was about to be started. During this entire period it has been Mr. King's responsibility to maintain the high standards of the appearance and arrangement of this most recent addition to the publications of the Society. He has carried similar responsibility with respect to the illustrations for PROCEEDINGS. All of his work has been distinguished by fidelity and quiet efficiency.

His most recent problem has been the government curtailment in the use of paper. This has resulted in thinner issues, elimination of reprints, restriction of issue, and finally in smaller over-all dimensions for CIVIL ENGINEERING, beginning with the July issue. (See "CIVIL ENGINEERING Cuts Its Coat to Fit," June, p. 289.)

He has established a high standard of quality and, at the same time, effected many economies. On account of his character and his work he will be greatly missed. As a token of their regard, Mr. King's friends in the office presented him with a brief case at a farewell luncheon held in the dining room of the Engineers' Club. To his war work he carries the best wishes of his associates.

Plan Postwar Works Now

"PLAN NOW!" has been the constant plea of the Society's Committee on Postwar Construction. Public and private works must all be beyond the listing stage if the waste of made-work projects in the postwar period is to be avoided. Since the formulation of the Society's attitude toward postwar planning (CIVIL ENGINEERING, September 1943, page 439) members of the committee, Society officers and staff, have been active in urging preparation of plans.

Public meeting, press, and radio have all been pressed into service to carry this message to engineers and administrators. G. Donald Kennedy, M. Am. Soc. C.E., Chairman of the Committee on Postwar Construction, speaking before the Associated General Contractors of America at their Chicago meeting, analyzed the planning situation in city and state highway departments.

"With few exceptions," he reported, "cities and states are marking time on actual postwar planning. Their plans either are long-range programs, which cannot possibly be ready to start when jobs are needed after the war, or else they are listing a patch-work of desirable but unimportant jobs that fail entirely to embrace our real postwar need.

"All too few are the cities and states that have appropriated money for actual work right now to get blueprints drawn, land acquired and legal obstacles overcome, so that men can go to work when the war factories close and the armed forces are being demobilized."

On August 17, the American Forum of the Air discussed "Will We Need a WPA After the War?" Representing the Society at this forum, Secretary George T. Seabury stated:

"It is not safe to assume that industry can absorb all those who are to be demobilized from the armed forces and those workers who are to be dislocated from factories . . . .

"It is our view, therefore, that now, at the present time, such effective designing of public works, such complete drafting of specifications and contract documents, and such coordinated legal and financial arrangements should be undertaken that the already existing reservoir of needed, useful, and economically sound public works projects shall be ready to be constructed through the regular contract system the moment the war is over."

It has been the aim of the committee to lead other professional organizations to active participation in the program. Hal H. Hale, Society Representative in Washington, and D. K. Este Fisher, Jr., of the American Institute of Architects, have combined their efforts to assist the Chamber of Commerce of the United States in the preparation of a promotional pamphlet entitled "Plan Now for Future Public Works." Embodying the attitude of the Society, this pamphlet will circulate widely throughout the business world.

As a summation of the cooperative effort needed, the pamphlet states:

"It is to be remembered that people acting in a group can accomplish that which no individual acting alone could ever hope to bring about. Convince yourself that postwar public works planning is needed now; join with others who hold the same belief, and the job is well on its way toward accomplishment. Make it your own problem—and do something about it."

Former Editors of CIVIL ENGINEERING Honored

Two former editors of CIVIL ENGINEERING—Donald P. Barnes and Don Johnstone—have recently been promoted in their respective branches of the Armed Services. On August 17 the War Department announced that Mr. Barnes is being temporarily promoted from the rank of major in the Corps of Engineers, U.S. Army, to that of lieutenant colonel. He is now on an assignment in the West and was formerly assistant executive officer and chief of the Camouflage Section at Fort Belvoir, Va.

Similarly, Mr. Johnstone has been promoted from the rank of lieutenant in the Civil Engineer Corps of the U.S. Naval Reserve to that of lieutenant commander. He is head of the administrative section of the War Plans Division at the Bureau of Yards and Docks in Washington, D.C.

News of Local Sections

Scheduled Meetings

CLEVELAND SECTION—Lecture on astronomy at the Case Observatory, on October 8.

DAYTON SECTION—Luncheon meeting at the Engineers' Club on October 18, at 12:15 p.m.

LOS ANGELES SECTION—Dinner meeting at the University Club on October 13, at 6:30 p.m.

METROPOLITAN SECTION—Technical meeting at the Engineering Societies Building on October 20, at 8 p.m.

MIAMI SECTION—Dinner meeting at the Seven Seas Restaurant on October 7, at 7 p.m.

PHILADELPHIA SECTION—Dinner meeting at the Engineers' Club on October 12, at 6 p.m.; meeting at 7:30 p.m.

ST. LOUIS SECTION—Luncheon meeting at the York Hotel on October 25, at 12:15 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12 m.

SAN FRANCISCO SECTION—Dinner meeting at the Engineers' Club of San Francisco on October 19, at 5:30 p.m.

SEATTLE SECTION—Dinner meeting on October 25, at 6:15 p.m.

TENNESSEE VALLEY SECTION—Dinner meeting of the Knoxville Sub-Section at the S & W Cafeteria on October 15, at 5:45 p.m.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Y. M. C. A. on October 4, at 12:15 p.m.; luncheon meeting of the Fort Worth Branch at the Blackstone Hotel on October 11, at 12:15 p.m.

WEST VIRGINIA SECTION—An afternoon meeting at the Kanawha Hotel, Charleston, W.Va., on October 1, at 2:30 p.m., followed by a dinner meeting at 6:30 p.m.

WISCONSIN SECTION—Joint dinner meeting with the University of Wisconsin Student Chapter at the Wisconsin Union on October 28.

Recent Activities

PANAMA SECTION

Continuing the series of talks planned to acquaint the membership with the duties, aims, and problems of the various departments and divisions of The Panama Canal, the program committee for the June meeting had arranged for Captains Manahan and Kiernan to represent the Marine Division and J. G. Claybourn, the Dredging Division. A capacity crowd turned out to hear their talks.

SACRAMENTO SECTION

Two of the five weekly luncheon meetings in August were devoted to accounts of engineering experiences of Sacramento engineers in far places. On August 3, Ottomar T. Illerich told of his work in Fort St. John last winter, designing bridges for the Alcan Highway; and on August 31, Evan W. Vaughan detailed a 20-month assignment in Venezuela on water supply and sanitation projects, which constituted the beginning of a comprehensive program of public works. Capt. Harry Randell, of the Ordnance Department of the U.S. Army, demonstrated new automatic arms and booby traps at an evening meeting on August 24.

SAN FRANCISCO SECTION

The technical program at the regular bimonthly meeting, held on August 17, consisted of an address by H. B. Walker, professor of agricultural engineering at the University of California Experiment Station. In his talk—entitled "Flood, War, and Diplomacy from the Viewpoint of an Engineer"—Professor Walker pointed out that the demands made upon the farmers of the nation have exceeded their productive capacity, which has been deteriorating since our entrance into the war because of the lack of a well-defined and properly implemented program. Lack of labor, equipment, and suitable transportation for farm products are the bottlenecks that must be corrected if the food situation is to be improved, he stated.

"Should the Japanese Be Allowed to Return to the Pacific Coast?" was the topic of discussion at the July 15th meeting of the Junior Forum. There was also a talk by Walter Wagner, of the H. J. Kaiser Company, on design and production at the Fontana Steel Mill.

TENNESSEE VALLEY SECTION

The guest of honor and speaker at the August 18th meeting of the Knoxville Sub-Section was Dr. Karl Terzaghi, well-known authority on soil mechanics. Dr. Terzaghi discussed the stability of embankments on foundations with clay strata, citing numerous examples of the failure of earth dams. The meeting marked the high point of the year in attendance and interest.

Student Chapter Notes

UNIVERSITY OF CALIFORNIA

The consistent interest of this Chapter in Society and Student Chapter affairs is notable. Attention is directed to the list of 1943 graduates applying for Junior membership and printed in this issue. It contains 60 from the University of California. For a number of years recently their list has been the largest, or one of the largest, submitted. Such a result indicates a gratifying interest in professional matters and reflects credit on the teaching staff as well as the engineer student body. The record is a fine one for all Student Chapters to emulate.

ITEMS OF INTEREST

About Engineers and Engineering

Fire Prevention Week Carries a Warning

By ROBERT S. MOULTON

TECHNICAL SECRETARY, NATIONAL FIRE PROTECTION ASSOCIATION

FIRE PREVENTION WEEK, beginning October 3, has unusual significance this year for the professions engaged in building the industrial plant whose full production is necessary for victory.

Vital production of steel, magnesium, chemicals, bombs, arms, and ships has been delayed in the past year by fires occurring in buildings under construction. Some twenty-five such fires of major importance have been reported to the National Fire Protection Association since Pearl Harbor. These fires in buildings and other engineering structures vital to the war effort have had consequences far more serious than the immediate property damage measured in millions of dollars. For example, a $250,000 fire in one key unit of an important war production plant in course of construction held up the completion of the entire plant and caused an estimated loss of 10,000,000 man-hours of production. Military secrecy prevents giving the details of many of these fires. In the aggregate, they have handicapped the war effort to a much greater extent than anyone realizes.

Most of these fires could be prevented or controlled with a minimum of loss by observing the established standards for fire prevention and extinguishment developed by the technical committees of the National Fire Protection Association. Fire safety should be regarded as an integral part of engineering design, not as something added after the structure is completed. If the engineer will give thought to the fire hazards in all stages of a construction project, many obvious fire causes can readily be eliminated.

The fire record all too clearly shows that many buildings, bridges, dams, tunnels, and other structures constructed of fire-resistive materials and properly designed for fire safety when completed, present very serious fire hazards during the construction period. In addition to the hazard of wooden formwork, tarpaulins and other construction materials, it is unfortunately common practice to delay the installation of automatic sprinklers, hydrant systems and other fire protection equipment until other work is completed. For fire safety, all fire-protection construction should keep pace with other construction, and where necessary temporary equipment should be installed for fire extinguishment during the construction period.

Under war conditions the normal hazards have been greatly increased. The necessity of conserving critical materials has compelled the extensive use of wood in place of fire-resistive materials, and the pressure of speedy construction has resulted in taking all sorts of chances with fire—chances which in many cases are wholly unnecessary. A little time saved on a construction job by forgetting fire safety may result in a fire which delays the completion of the whole job by months.

The principal causes of fires in course of construction are shown in Table I, compiled from 138 fires in buildings in course of construction reported to the National Fire Protection Association. This is not by any means a complete record but is a representative sample of typical fires. The total known losses from these fires amounted to $6,453,509.

TABLE I. PRINCIPAL CAUSES OF CONSTRUCTION FIRES

CAUSES	TOTAL FIRES CAUSED	% OF KNOWN CAUSES
Salamanders	37	34.5
Gas explosions	2	1.9
Spontaneous ignition	1	.9
Acetylene torch	25	23.4
Electrical	6	5.6
Tar or pitch kettle	6	5.6
Forge	2	1.9
Smoking	10	9.4
Hot rivets	10	9.4
Miscellaneous known causes	8	7.4
Total known causes	107	100.0
Unknown causes	31	22.3

Buildings in the course of construction ordinarily have many fire hazards not found in completed structures. Fire protection equipment to prevent the spread of fire has not yet been installed, while the numerous forms and accumulated building materials, temporary ladders, and other necessary conditions impede the fire department in fighting fires that may occur.

Recommended good practice requires that adequate precautions be taken. It is desirable, for instance, to use suspended scaffolding made of non-combustible supports and flameproofed planking wherever possible in order to minimize the amount of scaffolding that may be exposed in case of fire. Recently improved flameproofing materially decreases the susceptibility of planking to ignition from a small source of heat and retards the spread of flame along the surface. Flameproofed scaffolding may not be necessary in buildings of six stories, or up to 75 ft in height, which do not have a ground area of more than 10,000 sq ft, provided they are readily accessible to the operations of the fire department.

The ideal condition would be the use of flameproofed material for all forms, but this does not appear to be economically practical at the present time. However, in using ordinary wooden forms, rigid fire prevention rules should be enforced.

Accumulation of forms should be avoided on the floors between shores when forms are being moved from floor to floor. All broken forms and other flammable waste materials should be promptly removed from the building.

The number of floors where forms are being set at one time should not be more than three in advance of the three floors in the process of setting.

No part of the building where forms are in place should be used for the storage of flammable building supplies.

All temporary closures in window and door openings and around scaffolding should be of slow-burning materials.

TARPAULINS CARELESSLY STORED TOO NEAR A SALAMANDER CAUSED THIS COSTLY CONSTRUCTION FIRE

No building material should be disposed of by building bonfires on the floor arches or by burning in salamanders.

THE CONTRACTOR ON THIS PUBLIC BUILDING SUFFERED SUBSTANTIAL LOSS BECAUSE INADEQUATE FIRE-FIGHTING EQUIPMENT WAS SUPPLIED ON THE JOB SITE

The hazard of salamanders is probably next to that of temporary woodwork. These should be substantially constructed, not easily overturned and restricted to the use of coal, coke, or kerosene as fuel. They should also be under the constant supervision of an attendant armed with a fire extinguisher, on every floor where they are used. The coal or coke heater should have an ash-receiving metal bottom, at leas 6 in. from the floor, with a clearance of 2 ft or more horizontally and 6 ft vertically between the heater and combustible material. A substantial wire screen of $\frac{1}{2}$-in. mesh should be fitted over the top of the heater. Temporary tarpaulins should not be closer than 10 ft, and they should be securely fastened, as many fires are caused by tarpaulins blowing loose and igniting from salamanders.

A short time ago, during the erection of a new plant for the Pratt and Whitney Aircraft Corporation, a tarpaulin, blown loose by the wind, whipped against a coke-fired salamander and was ignited. However, fire watchers had been appointed and one was at the scene quickly. Fire extinguishers were handy and the fire was rapidly put out. Thus destruction of a large area of formwork and a serious setback to war production was averted by quick action.

For fusion welding and cutting processes, asbestos blankets or other fire-resisting materials will protect the surroundings, and at noon and at the end of the day, the surroundings should be thoroughly wet down. During the welding and cutting operations, fire watchers equipped with extinguishers should stand by, ready for any fire that may be caused by flying sparks.

Flammable liquids can only be safely stored or handled in the building providing they are in approved portable tank wagons or safety cans. Reserve storage should be at a safe distance from the building and under lock and key. Tar kettles also should be located outside the building.

Although it does not appear practical to prohibit smoking generally, it should be prohibited at least in hazardous parts of the building.

For fire-fighting purposes, at least one elevator should be installed in buildings of six stories or over 75 ft in height, and it should be in charge of a competent operator both day and night. As the work progresses, at least one stairway should be provided to the highest floor under construction, and maintained in serviceable condition. Standpipes are carried up as construction progresses, ready for use by the fire department. These are equipped with a siamese fire department connection outside the building at street level, with at least one standard hose outlet on each floor. Temporary water pipes can be extended into the property and small hose provided at suitable locations. Sprinklers should be installed, connected, and ready for use as the work progresses. Fire extinguishers of non-freezing types should be located near salamanders, in offices, tool houses, dressing rooms, workshops, and other important points.

All electrical wiring or equipment for light, heat, or power should be approved by the proper inspection authorities.

Workmen's shanties within 30 ft of the building should be constructed of non-combustible materials, and equipped with non-freezing extinguishers.

A person of intelligence and tact should be vested with authority to supervise the installation and maintenance of fire-protection equipment and fire-prevention measures. He will require the removal of unnecessary materials and waste and generally supervise all operations with respect to fire hazards. The fire warden should also supervise the watchman, who should make half-hour rounds for two hours after the suspension of work and hourly rounds thereafter, registering by means of an approved watchman's clock from stations covering all parts of the building. Preferably this will be an approved combination fire-alarm and central-station watch.

During the existing war period, the possibility of fire damage to buildings and other structures under way is greater because of the haste with which they must, in most cases, be built. Inadequate fire protection and fire prevention, however, has often proved its costliness and has contributed its own brand of sabotage to war production and victory.

N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

THE PROFESSOR unrolled a big chart (Table I) and pinned it to the wall. "I hope," he said, "that some of you know more about baseball than Amos Keatow. Amos thot 3 nautical miles made a major league and 3 statute miles a minor league, adding that Hosmer didn't define a bush league, but it was probably 3 crooked miles by trail beating around the bush.

"This chart reproduces the incomplete major league standing which was shown to the Engineers Club by Secretary Berry last August. Will some one step up and complete it so as to satisfy the given conditions?"

"I'll tackle anything that easy," volunteered Joe Kerr. "Just to show that my solution fulfills the condition that Antville played the most and Hippodelphia the least games, I've added another column headed '*Games*' at the right. The total of this column gives the answer—990 games."

"I'd cut that in two," suggested Ken Bridgewater. "Since two teams participate in each game, there must have been only 495 games altogether."

"I think Joe and Ken have overlooked something else," remarked Cal Klater stepping up to the chart. "Watch me add the 'W' and 'L' columns—494 games won in the league but 496 games lost. I can correct that by revising Cowtown's score to 78 games won and 52 lost; then the totals agree that 500 games had been played."

"Stupendous," agreed the Professor. "Strange as it may seem, the record books do not always tally the 'W' and 'L' columns alike. For example, two teams dropped out of one minor league in midseason some years ago, leaving such a discrepancy in the standings of the other six teams for the rest of the season. Do you all agree with '500' for the answer?"

"They had best agree," said O'Kay, "for I've proved it to be the only possible answer. I also proved that it was unnecessary for you to add the condition that not more than one game in seven was rained out, but I'll grant that such a condition made the problem appear more difficult."

"Right," agreed the Professor. "That extra condition was unintentional, but another was added purposely, the implied limit of 154 games to a major league season. Sometimes so many extraneous data can be included in a problem that the problem is hard to find. That's true in everyday engineering studies—and in the following question:

"Septimus Heptason was born a seventh son of a seventh son, weighing seven pounds and seven ounces, on Seventh

TABLE I. ZOOLOGICAL LEAGUE

	W	L	PCT	*Games*
Antville	*99*	*33*	0.750	*132*
Beeburgh	*80*	*48*	0.625	*128*
Cowtown	*72* (78)	*48* (52)	0.600	*120* (130)
Dogland	*63*	*62*	0.504	*125*
Elk Rapids	*54*	*66*	0.450	*120*
Fleaborough	*55*	*70*	0.440	*125*
Gnatopolis	*48*	*77*	0.384	*125*
Hippodelphia	*23*	*92*	0.200	*115*
	494 (500)	*496* (500)		*990* (1,000)

Avenue, New York, on the seventh day of the week, and the seventh day of the month. He cut his seventh tooth on the seventh day of the seventh following month and the seventh day of the week. When did he celebrate his seventh birthday?"

[Cal-Klaters-of-the-month were: A Nuther Nutt (that man again), James R. Bole, Lee Hi (Mason D. Pratt), Barney (Francis S. Harvey), Richard Jenney, John C. Prior, Lt. Byron A. Bledsoe, Robert W. Woodbury, Cpl. Irving Last, and O'Kay (Otto H. S. Koch). Five of these were Joe-Kerrs-of-the-month, but I won't say which, since they second-guessed correctly.]

Civilian Defense Work in Hawaii

From a Letter to E. P. Goodrich, M. Am. Soc. C.E., National Chairman, Society's Committee on Civilian Protection in Wartime

By ARTHUR R. KELLER, ASSOC. M.AM.SOC.C.E.
VICE-PRESIDENT, UNIVERSITY OF HAWAII
HONOLULU, HAWAII

A NOTE from Hawaii may be of interest. Here many of the war activities have reached the complacent stage and new activity must be awakened, or former interest maintained. Many of our local firms are using their advertising space for this purpose.

Nearly every adult person in the Territory has completed one or more defense courses, such as first aid, bomb disposal, bomb spotting, and each individual has an assignment in the event of an emergency. At present, the OCD is sponsoring a series of brief but to-the-point "refresher" statements. Each day a short article appears in a local paper.

Another matter that may be of interest is the cooperation of the householder in providing protection for his home. At each entrance to practically every home in Hawaii will be found one or more large buckets, or containers, filled with sand. The bucket is protected to keep it dry. In the yard there will be containers filled with water, and a hose, or more than one if there are a number of faucets, attached to the water system ready for immediate use. Near the sand bucket will be seen a long-handled shovel, its handle painted red. The home is ready for an emergency and can fight a small fire if an incendiary falls near it.

For the larger buildings, the problem was complicated. In Hawaii many buildings of a public or semi-public character are built largely of wood. Such a building covers quite a floor area but is limited in height. To protect these buildings presented some difficult problems. Sand, shovel, and equipment placed in boxes at strategic points has been the common answer.

At the University I felt that we should be able to take the fire-fighting equipment to the spot, intact, in a minimum of time, so planned a small complete cart on which are placed two buckets of sand, a bucket of water, a galvanized tub, a shovel, an axe, goggles, a stirrup pump, and 50 ft of hose. There is one cart on each floor, which can be rushed to the danger spot immediately. The hose is added because on each floor we have at least one hose bibb in a corridor.

You may be interested in our home gardens. In my home, we have always had flowers but since the war began we have changed and are raising vegetables. The garden covers an area of about 30 by 50 ft. We have very good broccoli, cabbage, beans (string and lima), beets, carrots, lettuce (we do not like celtus), greens (spinach, mustard greens, wom-back, Swiss chard, Australian spinach), tomatoes (with varied success), and now we are trying soy beans. We have had green corn in season. On the top of our air-raid shelter we have sweet potato vines which keep us in sweet potatoes. We raised one crop of Irish potatoes but have insufficient land for this crop. Our garden is merely typical of the home garden found throughout the residential districts. In many places, the government has ploughed vacant land and assigned plots to those who have insufficient area of their own. These community gardens are doing well.

NEWS OF ENGINEERS

Personal Items About Society Members

A. E. NIEDERHOFF, formerly senior structural engineer for the U.S. Army Engineers at Portland, Ore., recently accepted the position of design engineer with the Oregon Shipbuilding Corporation—one of the three Kaiser shipyards in the Portland area.

CALVIN C. OLESON, for the past two years acting head of the department of civil engineering at South Dakota College, has accepted the commission of captain in the Corps of Engineers, U.S. Army, and has reported to Fort Belvoir, Va., for officers' basic training.

LAWRENCE M. FRIEDRICH, associate professor of civil engineering at the University of Toledo, has been appointed head of the EMWT program at the university.

KATHLEEN F. LUX, a Junior in the Society and ensign in the Waves, has been assigned to the Civil Engineer Corps of the U.S. Navy in Washington, D.C. Ensign Lux, following her graduation from Purdue University in 1942, was with the Indiana State Board of Health in her special field, sanitary engineering. She joined the Waves in 1943 and is the first woman to have a commission in the Civil Engineer Corps.

S. C. WILLIS, formerly New York district superintendent for the H. K. Ferguson Company, industrial engineers and builders, has been appointed production manager for the National Company, radio engineers and manufacturers, of Malden, Mass.

SIDNEY M. MARKS has been promoted from the rank of lieutenant in the Sanitary Corps, A.U.S., to that of captain. He is stationed at the Nashville (Tenn.) Army Air Center.

NATHAN L. SMITH, project manager for the J. E. Greiner Company, of Baltimore, Md., was recently appointed chief engineer of Baltimore and head of the Department of Public Works.

HARRY VOUGHT, lieutenant commander, U.S. Navy, has been detailed to the Allentown (Pa.) division as Inspector of Naval Aircraft. He was previously stationed at the Bureau of Aeronautics in Washington, D.C.

ROBERT K. SCHRADER, first lieutenant in the Air Corps and Flight Commander in the 533 Squadron, 381 Bomb Group, was listed as "missing in action" over Vegesack, Germany, on June 25, 1943. Lieutenant Schrader graduated from the University of Pittsburgh in 1940 and received his M.C.E. at Cornell in 1941, entering the Army immediately thereafter.

LESLIE D. CABANISS is now a first lieutenant in the Army, stationed at Fort Belvoir, Va. Before receiving his commission, he was senior resident engineer for the Texas State Highway Department at Paris, Tex.

WILLIAM E. R. COVELL recently received a temporary promotion from the rank of colonel in the Corps of Engineers, U.S. Army, to that of brigadier general. He is located at Crossett, Ark.

M. P. O'BRIEN, professor of mechanical engineering at the University of California, has been appointed dean of the college of engineering.

LEWIS W. MCINTYRE, Pittsburgh (Pa.) consultant and traffic expert, has been commissioned a major in the U.S. Army and will train at Fort Custer, Mich. Major McIntyre designed Pittsburgh's downtown traffic signal system, said to be the largest flexible progressive traffic signal system in the world.

SAMUEL J. MATHIS, lieutenant, CEC, U.S. Naval Reserve, was recently awarded the Legion of Merit by Lt. Gen. Millard F. Harmon, commanding general of the U.S. Army forces in the South Pacific area. He received the citation for his services as naval construction officer in charge of building four airfields in the South Pacific area.

PAUL M. ZANDER is now a lieutenant in the Construction Battalions of the U.S. Navy, the rank representing a promotion from that of lieutenant (jg).

J. M. JARRETT is now director of the division of sanitary engineering of the North Carolina State Board of Health. Since November 1942, he has been on duty with the U.S. Public Health Service as a sanitary engineer, with the rank of major.

RAYMOND G. RIDGELY, superintendent of the St. Petersburg (Fla.) water supply system, has been appointed acting city manager.

CARL H. COTTER, captain, CEC, U.S. Navy, was recently named director of the Pacific division of the Bureau of Yards and Docks.

JOHN T. TUCKER is now a lieutenant in the Construction Battalions of the U.S. Navy. Prior to receiving his commission, he was North Dakota state engineer.

SPENCER J. BUCHANAN, captain, Corps of Engineers, U.S. Army, has been assigned to new duties at Little Rock, Ark., where he will be assistant to the district engineer.

DECEASED

JAMES CARSON AGNEW (M. '34) vice-president of Winston Brothers Company, Los Angeles, Calif., died recently. He was 61. From 1904 to 1919 Mr. Agnew was with the Mahoning Ore and Steel Company at Hibbing, Minn., in various capacities. For the next four years he was assistant to the president of the Midvale Steel and Ordnance Company at Philadelphia, Pa., and from 1923 to 1926 was president of the Agnew-Batteiger Company, of the same city. Since 1929 Mr. Agnew had been director and vice-president of Winston Brothers at Los Angeles.

ROBERT CLINTON BAKER (Assoc. M. '35) of Morro Bay, Calif., died on July 31, 1943, at the age of 61. Mr. Baker had been with the Tennessee Copper Company and the Miami (Ariz.) Copper Company, and from 1917 to 1922 was construction engineer for the Montezuma Copper Company (Phelps Dodge). Later he was with the Cananea (Mexico) Consolidated Copper Company on smelter reconstruction, and from 1933 to 1935 was project manager for Pima County (Calif.) on FERA work.

JOHN WALTER FRINK BENNETT (M. '17) consulting engineer of New York, N.Y., died at his home in that city on August 31, 1943. He was 68. During more than forty years of engineering experience in New York and London, Mr. Bennett was engaged on the construction of many well-known buildings and projects, including a large Army supply base in Brooklyn and the Ritz Hotel in London. For several years he was Deputy Commissioner of Water Supply, Gas and Electricity in New York, and he had also been in charge of the project planning division of the Work Projects Administration in New York.

WILLIAM HENRY CONNELL (M. '17) of Ventnor City, N.J., died at his home there on August 3, 1943, at the age of 65. Early in his career Mr. Connell was engaged in highway and bridge construction work for the Boroughs of New York and Brooklyn. Beginning in 1912, he was for a number of years chief of the Philadelphia Bureau of Highways, and from 1929 to 1939 was executive director of the Tri-State Regional Planning Federation, with headquarters in Philadelphia. More recently he was assistant director of public works in Philadelphia.

ARTHUR ROSCOE CORNELL (Jun. '40) lieutenant, Ordnance, U.S. Army, died recently in the Philippines, where he was a prisoner of the Japanese. He was 23. A graduate of Purdue University, where he held a reserve officer's commission, Mr. Cornell was called into active service in March 1941. He was attached to the field artillery before being sent to the Philippines in June 1941 with the ordnance branch of the U.S. Air Corps.

ASA REDMOND DIMOCK, JR. (Jun. '35) an engineer in the employ of the Petro-Chem Development Company, of New York, N.Y., died suddenly at Coytesville Park, N.J., on August 4, 1943. He was 28. An alumnus of Rensselaer Polytechnic Institute, Mr. Dimock was for several years assistant engineer for Ford, Bacon and Davis. He had also been in Bermuda on a government project.

THOMAS EARLE (M. '07) president of Thomas Earle and Sons, Inc., of Philadelphia, Pa., died in that city on August 15, 1943. Mr. Earle, who was 77, was for some years vice-president of the Bethlehem Steel Company. During this period he was instrumental in the design and construction of the Delaware River bridge between Philadelphia and Camden, N.J., and of bridges over the East River at New York and over the Niagara River. About twenty years ago he established the consulting firm of Thomas Earle and Sons, Inc.

NATHAN ELIAS ELKIN (Jun. '32) engineer for the Lieb Construction Company, of New York, N.Y., died on June 22, 1943. Mr. Elkin, who was 32, graduated from New York University in 1932, receiving the degree of B.S. in C.E. For the past several years he had been with the Lieb Construction Company.

OSCAR ERLANDSEN (M. '96) former consulting engineer to the Borough of Queens, died in a hospital at Huntington, N.Y., on August 17, 1943. His age was 78. Early in his career Mr. Erlandsen was supervising engineer on the construction of Hudson River tunnels for both the Pennsylvania Railroad and the Hudson and Manhattan Railroad. From 1906 to 1928 he was a member of the civil engineering and surveying firm of Erlandsen and Crowell, which is located in Jamaica (Queens), N.Y. From 1929 until his retirement in 1939 he was, successively, superintendent of sewers and consulting engineer for the Borough of Queens.

JAMES DEARING FAUNTLEROY (M. '07) died at Altavista, Va., on July 20, 1943, at the age of 74. Mr. Fauntleroy was for a number of years senior highway engineer for the Public Roads Administration at Richmond, Va. Earlier in his career he was district engineer for the Administration at Fort Worth, Tex. He retired in 1939.

JOHN AUBREY FOULKS (M. '22) who for the past year had been with the Reconstruction Finance Corporation, in Washington, D.C., died on August 30, 1943. He was 67. Mr. Foulks had been former chief water engineer for Newark, N.J., and for some years was a partner in the consulting firm of Schermerhorn and Foulks, of Newark. During the first World War he served overseas in the Army Ordnance Corps, having the rank of captain.

JAMES ALBERT HAMMACK (M. '24) project engineer for the Florida State Road Department at Leesburg, Fla., died on August 9, 1943. Early in his career Mr. Hammack was with the Florida East Coast Railway. He had also been assistant engineer of Jackson, Miss. (1908 to 1911), and from 1911 to 1913 was consulting engineer for Rankin County, Miss. Later Mr. Hammack was in private practice, and from 1920 on he was project engineer for the Florida State Road Department.

GEORGE CONDIT HAYDON (M. '14) retired engineer of Kansas City, Mo., died on June 23, 1943. Mr. Haydon, who was 82, spent practically his entire career in the Corps of Engineers, U.S. Army, having become connected with it in 1890. From 1909 until his retirement in 1934, he was principal assistant engineer for the Missouri River Improvement at Kansas City.

WINFRED DEAN HUBBARD (M. '36) division engineer for the New York City Department of Water Supply, Gas and Electricity at Kingston, N.Y., died recently at the age of 66. From 1906 to 1917 Mr. Hubbard was assistant engineer with the New York Board of Water Supply. From the latter date to 1931 he held a similar position with the Department of Water Supply, Gas and Electricity. He then became division engineer in charge of the Catskill-Croton Division.

RALPH WALDO LAWTON (M. '22) consulting engineer of Los Angeles, Calif., was fatally stricken with a heart attack while driving to his home on August 20, 1943. Mr. Lawton, who was 74, was for some years Pacific Coast sales agent and engineer for the Nye Odorless Incinerator Corporation. Earlier in his career he was employed by the British government to build water works and irrigation systems in Egypt, Palestine, and India.

LEON SOLOMON MOISSEIFF (M. '07) consulting engineer of New York, N.Y., died at his summer home at Belmar, N.J., on September 3, 1943. Mr. Moisseiff, who was 70, was consulting engineer or designer on practically all the bridges connecting New York's five boroughs and on such spans as the Golden Gate Bridge at San Francisco, the Ambassador Bridge at Detroit, and the Delaware River Bridge at Philadelphia. Born in Riga, Latvia, Mr. Moisseiff was educated there and at Columbia University in New York. In 1929 he was engaged to go to Russia in connection with the Soviet five-year program of construction, and in 1933 he was consulting engineer to the Century of Progress Exposition in Chicago. He was the author of numerous volumes on bridge design and engineering, and the recipient of the Society's James Laurie Prize and the Norman Medal.

HENRY JENNESS SAUNDERS (M. '15) consulting engineer of Washington, D.C., died on August 14, 1943, at the age of 63. Mr. Saunders was with the Union Pacific Railroad from 1899 to 1909; with Ford, Bacon and Davis from 1909 to 1912; supervising engineer for the Pacific District of the Interstate Commerce Commission from 1914 to 1921; and assistant supervising engineer for the Bureau of Valuation of the Interstate Commerce Commission from 1921 to 1928. Since the latter date he had been a consultant on transportation and allied problems.

CHARLES FRANK SEIFRIED (M. '39) superintendent of the Wyoming State Highway Department, Cheyenne, Wyo., died of a heart attack on July 21, 1943, while on an inspection trip at Cody, Wyo. Mr. Seifried, who was 58, was one of the oldest employees in the highway department, having joined it in 1919. For a number of years he was engineer of plans

and office engineer, and in 1939 became chief highway engineer. In January 1943 he was promoted to highway superintendent.

WILLIAM WESLEY VARNEY (M. '18) patent lawyer of Baltimore, Md., died on July 30, 1943, at the age of 78. Early in his career (1899 to 1900) Mr. Varney was city commissioner of Baltimore, and at various times he had been harbor engineer. From 1893 to 1899 and, again, from 1903 to 1917 he maintained a consulting practice in Baltimore. Since 1918 he had been an expert in patent cases.

JOHN WILSON (M. '31) consulting engineer of Duluth, Minn., died in that city recently. Mr. Wilson, who was 67, was city engineer for Mankato, Minn., from 1908 to 1912, and city engineer for Duluth from 1912 to 1933. He later worked as an engineer for the Canadian government and for the city of Superior, Wis., and more recently maintained a consulting practice in Duluth.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From August 10 to September 9, 1943, Inclusive

ADDITIONS TO MEMBERSHIP

BAKER, RALPH HUBERT, JR. (Jun. '43), 2d Lt., Corps of Engrs., U.S. Army, 192 Bartlett Rd., Winthrop, Mass.

BARNES, JAMES ALAN (Jun. '43), Ensign, CEC, U.S.N.R., 271 East North Ave., Elmhurst, Ill.

BECK, ALLAN FRANK (Jun. '43), 2d Lt., U.S. Army, 29 Tremont St., Barre, Vt.

BELLUCCI, ACHILLES MARZORATI (Jun. '43), 2d Lt., Corps of Engrs., U.S. Army, 44 Ayers St., Barre, Vt.

BERGH, PAUL SUNDBY (Jun. '43), 2d Lt., Corps of Engrs., U.S. Army, 1310th Engr. Gen. Service Regiment, Camp Sutton, N.C.

BLACK, CHARLES WARREN (M. '43), Vice-Pres., The Arundel Corp., Pier 2, Pratt St. (Res., 329 Tunbridge Rd.), Baltimore, Md.

BLAIR, JAY WILLIAM (Jun. '42), Ensign, CEC, U.S.N.R., 1114 West 68th St., Los Angeles, Calif.

BLUMENSCHINE, ARTHUR EDWARD, JR. (Jun. '43), With U.S. Army Engrs., 59 Kenmore Ave., Newark, N.J.

BODNAR, WALDIMIR (Jun. '43), Senior Draftsman, Goodyear Aircraft Corp., Dept. 518, Plant D (Res., 395 Crouse St.), Akron, Ohio.

BOUTILIER, DOUGLAS SELDON (Jun. '43), Aviation Cadet, Air Corps, U.S. Army, 68 West Hill Ave., Melrose, Mass.

BRANDT, ROBERT FRANCIS (Assoc. M. '43), Asst. Engr. (Civ.), Morris Knowles, Inc., 1312 Park Bldg., Pittsburgh (Res., State Branch, Cresson), Pa.

BROWN, ROBERT HAROLD (Jun. '43), Ensign, U.S. Coast and Geodetic Survey, Box 448, Portland, Me. (Res., East Main St., Chatham, Mass.)

BURR, GEORGE SANFORD (M. '43), Engr., Test and Inspection, Wayne County Road Comm., 3800 Barlum Tower, Detroit (Res., 1463 Sheridan Ave., Plymouth), Mich.

CHASE, BURR LINDEN, JR. (Jun. '43), Private, U.S. Army, 365 Woodland Rd., Madison, N.J.

CHURCH, HERBERT STEPHEN, JR. (Jun. '43), Line and Grade Engr., Turner Constr. Co. (Res., 7 Nelson St.), Natick, Mass.

COHEN, JERRY (Jun. '43), Eng. Asst., Lockheed Aircraft Corp. (Res., 503 Andover Drive), Burbank, Calif.

CORBETT, HARRY HOWARD (Assoc. M. '43), Chf. Draftsman, Prouty Brothers Eng. Co., Box 475, Crawford, Nebr. (Res., 2804 Louisville St., El Paso, Tex.)

DARNELL, VICTOR CLEMENT (Jun. '43), Ensign, U.S.N.R., 821 Paxinosa Ave., Easton, Pa.

DI IORIO, ANTHONY FRANK (Jun. '43), Operator of Sewage Equipment, Post Engrs., Fort Monmouth (Res., 934 Main St., Fords), N.J.

DUDLEY, WINTHROP WALTER (Jun. '43), 2d Lt., Corps of Engrs., U.S. Army, Guilford, Conn.

ENGBROOK, GLENN HAROLD (Jun. '43), Aviation Cadet, Air Force, U.S. Army, El Campo, Tex.

EASTERDAY, EVERETT EARL (Jun. '43), Instr., School of Civ. Eng., Purdue Univ., West Lafayette, Ind.

FEAR, MILO CLYDE (Jun. '43), Asst. Eng. Officer, *U.S.S. Adhara*, Care, Fleet Post Office, San Francisco, Calif.

FENGER, ALBERT CHARLES (Jun. '43), Aviation Cadet, Air Corps, U.S. Army, Oxford, Miss.

FLYNN, FRANCIS JOSEPH (Jun. '43), Asst. Hydr. Engr., U.S. Geological Survey, 945 Post Office Bldg., Boston (Res. 213 Kelton St., Allston), Mass.

FONG, PAUL SUEY, JR. (Jun. '43), Structural Designing Engr., Eng. Design, Inc., 604 Mission St. (Res., 458 Grant Ave.) San Francisco, Calif.

FULLER, BERNARD ROY (M. '43), Hydr. Engr., TVA, 510 Union Bldg. (Res., 3212 Linden Ave.), Knoxville 15, Tenn.

GAFFNEY, THOMAS JOSEPH (Assoc. M. '43), Associate Engr., Bureau of Highways (Res., 9 East Mount Royal Ave.), Baltimore, Md.

GARMAN, RICHARD FRANKLIN (Jun. '43), Test Engr., Pump Eng. Service Corp., 12910 Taft Ave. (Res., 2050 East 83d St.), Cleveland, Ohio.

GARVIN, DANIEL FORD (Jun. '43), Ensign, CEC, U.S.N.R., 318 Straight St., Cincinnati, Ohio.

GOLDSTEIN, LOUIS GEORGE (Jun. '43), 166 East Beech St., Long Beach, N.Y.

GREVE, FREDERICK WILLIAM (M. '43), Prof., Hydr. Eng., Purdue Univ., West Lafayette, Ind.

HADLEY, WITT WILLIAM (M. '43), Engr., Bridge Constr. State Highway Comm., State House Annex (Res., 3117 Guilford Ave.), Indianapolis, Ind.

HANEY, PAUL DUNLAP (Assoc. M. '43), Chf. Engr., Div. of Sanitation, State Board of Health, Room 2, Marvin Hall, Univ. of Kansas, Lawrence, Kans.

HATCH, ARTHUR SELDEN (M. '43), Gen. Supt., Water Div., City of Houston, City Hall (Res., 4211 Jack St.), Houston, Tex.

HEER, JOHN EDWARD, JR. (Jun. '43), Ensign, U.S.N.R., 428 West College Ave., State College, Pa.

HEGERFELD, HENRY BISHOP (Jun. '43), Junior Stress Analyst, The Glenn L. Martin Co., Middle River (Res., 1659 Ralworth Rd., Baltimore 18), Md.

HEPPERT, ERNEST DAVID, JR. (Jun. '43), Ensign, CEC, U.S.N.R., 24 Fifth St., N.E., Barberton, Ohio.

HIESTAND, FRANCIS HALL (M. '43), Engr. and Project Mgr., S. J. Grover & Sons Co., Municipal Bldg., Ridgefield, N.J.

HOGAN, JOHN THOMAS (Jun. '43), Ensign, U.S.N.R., 185 Martin Ave., Palo Alto, Calif.

HOWE, ROBERT THEODORE (Jun. '43), With U.S.N., 1506 Knox St., Cincinnati, Ohio.

HUMPHREYS, HAROLD WESLEY (Jun. '43), Junior Naval Archt., U.S.N., Navy Yard (Res., 26 George St., Charleston), S.C.

INTLEKOFER, CHARLES FREDERICK (Jun. '43), Ensign, CEC, U.S.N.R., 307 East Main St., Waukon, Iowa.

JOHNSON, BRUCE MAXWELL (Assoc. M. '43), Liaison Engr., Light Div., Dept. of Public Utilities, City Hall Annex (Res., 3815 North 36th St.), Tacoma 7, Wash.

JONES, ARVON STANLEY (M. '43), Designing Engr., City of Des Moines, City Hall (Res., 2827 Logan Ave.), Des Moines, Iowa.

JONES, CALVIN MEYERHOFFER (Jun. '43), Copperton, Bingham Canyon, Utah.

KANE, DAVID (Jun. '43), Structural Engr., Grumman Aircraft Eng. Corp., Beth Page (Res., 286 Keap St., Brooklyn 11), N.Y.

KAPOR, JESSE (Jun. '43), Ensign, U.S.N.R., 1016 Lincoln Ave., Ann Arbor, Mich.

KETTNER, KARL HERMAN (Jun. '43), Asst. Engr., Standard Oil Co. of California, 225 Bush St., San Francisco (Res., 2466 Virginia St., Berkeley), Calif.

KIMMEL, WILLIS DOYLE (M. '43), Dist. Engr., Portland Cement Assn., 735 North Water St., Milwaukee, Wis.

KINNEAR, JOSEPH MILTON (Assoc. M. '43), Associate Civ. Engr., Bureau of Water Supply, 508 Municipal Bldg. (Res., 2823 Overland Ave.), Baltimore, Md.

KLYCE, HARVEY LOVELL (Jun. '43), With U.S.N.R., 34 Eugene St., Mill Valley, Calif.

KRICKENBERGER, CUSTER FRANKLIN, JR. (Jun. '43), Junior Highway Engr., U.S. Public Roads Administration, Fort St. John, B.C., Canada (Res., 2 Runyan Court, Lima, Ohio.)

KULICK, MATTHEW JOHN (Jun. '43), With U.S. Army, 166 East St., Pawtucket, R.I.

LA FORGE, HAROLD BYRON (Assoc. M. '43), Asst. Office Engr., State Div. of Highways, Public Works Bldg. (Res., 4581 Parkridge Rd.), Sacramento, Calif.

LANDIS, BRUCE RANDOLPH (Jun. '43), 2d Lt., U.S. Army, 3825 East 62d St., Kansas City, Mo.

LARIVIERE, FRANK JOHN (Jun. '42), With Air Force, U.S. Army, 268 Cartier St., Manchester, N.H.

LEIBER, HUGH CASS (Assoc. M. '43), Field Engr., Portland Cement Assn., 916 Northwestern Bank Bldg. (Res., 519 Essex St., S.E.), Minneapolis, Minn.

LENDERKING, CARROLL MILTON (Assoc. M. '43), Tool Designer, Spartan Aircraft Co., 1900 North Sheridan Rd. (Res., 2528 North Boston Pl.), Tulsa, Okla.

LINDSEY, RAY WARREN (Jun. '43), Asst. Field Engr., Dravo Corp., Neville Island, Pittsburgh 25, Pa.

LOUREKAS, CHRIST (Jun. '43), Stress Analyst, Consolidated Aircraft Corp. (Res., 4613 Lafayette St.), Fort Worth, Tex.

LOVE, JAMES SOMMERS (Jun. '43), Corporal, U.S. Army, 1017 Washington Ave., Findlay, Ohio.

MCAPEE, HAROLD KILMER (Jun. '43), Junior Naval Archt., U.S.N., Bethlehem-Hingham Shipyard, Inc., Lincoln St., Hingham (Res., 39 Grafton St., Brockton), Mass.

MCCLURE, GEORGE CAVE (Assoc. M. '43), Lt. CEC, U.S.N., 715 Don Gaspar, Santa Fe, N. Mex.

MCCOMBS, GLENN CALVIN (Assoc. M. '43), Asst. Prof., Carnegie Inst. of Technology, Schenley Park (Res., 4829 Baptist Rd.), Pittsburgh 10, Pa.

MCDONALD, ROLAND GEORGE (M. '43), Capt., Corps of Engrs., U.S. Army, Post Engr. Office, Camp Davis, N.C.

MCGOWAN, FORREST HALL (Assoc. M. '43), Engr. and Constr. Supt., Arundel Corp., Roosevelt Roads, Puerto Rico.

TOTAL MEMBERSHIP AS OF SEPTEMBER 9, 1943	
Members	5,985
Associate Members	7,290
Corporate Members	13,275
Honorary Members	32
Juniors	5,770
Affiliates	74
Fellows	1
Total	19,152
(Total September 8, 1942.	18,004)

McLAUGHLIN, ROBERT EDWIN (Assoc. M. '43), Chf. Engr., McCloskey & Co., Box 1728, Hooker's Point Shipyard, Tampa (Res., 707 Twenty-seventh Ave., North, St. Petersburg 4), Fla.

MAIA PENIDO, JOAO AUGUSTO (M. '43), Technical Asst. to Gen. Mgr., Airport Development Program, Pan. Am. Airways, Inc., Ave. Graca Aranha 226-sala 913 (Res., Rua Barao de Lucena 48), Rio de Janeiro, Brazil.

MAINQUIST, PAUL ARTHUR (Jun. '43), Eng. Apprentice, Supervisor's Office, P.R.R. (Res., 724 Jackson St.), Columbus, Ind.

MARTINDALE, GEORGE NORMAN (Jun. '43), Private, U.S. Army, 542 North Jackson St., Glendale, Calif.

MAXMIN, CONRAD (Jun. '43), Ensign, U.S.N.R., 6218 Washington Ave., Philadelphia, Pa.

MAYSON, ROBERT ORVILLE (Jun. '43), Capt., U.S. Army, 3317 South East 85th Ave., Portland, Ore.

MAYNARD, MILLARD FILLMORE (Jun. '43), 2d Lt., Corps of Engrs., U.S. Army, 565 West 15th St., San Pedro, Calif.

MEYER, CHARLES ARNOLD (Jun. '43), Liaison Engr., Dravo Corp., Neville Island, Pittsburgh (Res., 510 Grove, Sewickley), Pa.

MITCHELL, ROBERT WALLACE (Jun. '43), Junior Engr., Curtiss-Wright Corp., Port Columbus (Res., 146 South Garfield Ave., Columbus), Ohio.

MORRISON, RONALD LINTON (Jun. '43), Aviation Cadet, Air Force, U.S. Army, 126 Harvard St., Brookline, Mass.

NANCE, FREDERICK SHERMAN, JR. (Jun. '43), 2d Lt., Corps of Engrs., U.S. Army, 4000 Seventh St., Des Moines, Iowa.

NAVIN, PHILIP XAVIER (Jun. '43), Junior Engr., Goodyear Aircraft Corp. (Res., 157 Casterton Ave.), Akron, Ohio.

NEWLIN, JOHN TERHUNE (Jun. '43), Asst. Engr. and Operations Officer, 1882d Eng. Aviation Battalion, Elgin Field, Fla.

NOBLE, ROBERT JOSEPH (Jun. '43), Asst. Engr. (Civ.), U.S. Engr. Office, Honolulu, Hawaii.

NORDQUIST, EDWIN CLYDE (Jun. '43), Eng. Draftsman, Douglas Aircraft Co., Inc., Santa Monica (Res., 1226 McClellan Drive, West Los Angeles 25), Calif.

OLSEN, ARTHUR KERSHAW (M. '43), Capt., Specialist Reserves, U.S. Army, 234 South 7th East St., Salt Lake City, Utah.

OSBORNE, CLEO CHILTON (Assoc. M. '43), Asst. Engr., U.S. Engrs., Post Office Bldg. (Res., 1160 Robertson Way), Sacramento, Calif.

OSTERLING, BLAINE WARREN (Jun. '42), Field Engr., Canadian Kellogg Co., Drawer N (Res., 215 North Vidal St.), Sarnia, Ont., Canada.

PALLADINO, ANTHONY JOSEPH (Jun. '43), Aviation Cadet, Air Force, U.S. Army, 839 Madison Ave., Elizabeth, N.J.

PANEK, RICHARD EMIL (Jun. '43), Aviation Cadet, Air Force, U.S. Army, 1280 West 108th St., Cleveland 2, Ohio.

PELLER, CHARLES GEORGE (Jun. '43), Private, U.S. Army, 8019 Oglesby Ave., Chicago, Ill.

PIERCE, GUY ELLSWORTH (Jun. '43), Senior Highway Engr., County of Sacramento, Court House (Res., 1000 Fourth Ave.), Sacramento 14, Calif.

PRESCOTT, WILLIAM GAGE (Jun. '43), Sgt., U.S. Army, 15 South Bolton Ave., Indianapolis 1, Ind.

PROUTY, FRANK HARRISON (M. '43), Cons. Engr., Prouty Eng. Co., Exchange Bldg., 10th Floor (Res., 1760 Locust St.), Denver, Colo.

RICHARDS, ARTHUR HAYWOOD (Jun. '43), Junior Stress Analyst, Curtiss-Wright Corp., Plant II, Buffalo (Res., 5871 Main St., Williamsville), N.Y.

RICHARDS, JACK EDWARD (Jun. '43), 2d Lt., U.S. Army, 1028 Belmont Ave., Long Beach 4, Calif.

RIST, DONALD EDWARD (Jun. '43), Junior Engr., Airplane Div., Curtiss-Wright Corp., Lambert Field, St. Louis (Res., 2840 Walton Rd., Overland), Mo.

RITCHIE, WILLIAM DAVEY, JR. (Jun. '43), Junior Engr., Brewster Aeronautical Corp., Johnsville (Res., 55 West Oakland Ave., Doylestown), Pa.

ROCKWELL, HARVARD SELDON (Assoc. M. '43), Structural Engr., The Austin Co., Painesville, Ohio.

ROSE, HARMON ERNEST (Jun. '43), Corpsman, M. of W., P.R.R. (Res., 217 North 3d St.), Greenville, Ill.

RYER, WILLIAM THOMAS (Jun. '43), 6416 Fifteenth Ave., Brooklyn 19, N.Y.

SANDNER, FRANZ XAVIER, JR. (Jun. '43), Lt. (jg), U.S.N.R., 110 Cromwell Parkway, Norfolk, Va.

SCHMIDT, ROBERT JAMES (Jun. '43), 2d Lt., Corps of Engrs., U.S. Army, 710 Carlisle Ave., Dayton, Ohio.

SCHMITT, HARRY ALBERT (Assoc. M. '43), Capt., U.S. Army, 379 Harvard St., Cambridge, Mass.

SHIEFLO, JELMER BURTON (Jun. '43), Asst. Hydr. Engr., Mahoning Valley San. Dist., U.S. Geological Survey, Box 298 (Res., 58 Hilton Ave.), Youngstown, Ohio.

SHORT, ROBERT EARL (Jun. '43), Junior Naval Archt., Supervisor Shipbuilding, U.S.N., New York Shipbuilding Corp., Camden, N.J. (Res., 717 Prospect Ave., Prospect Park, Pa.)

SHOWMAN, ARTHUR CALDWELL (Assoc. M. '43), Senior Engr. (Civ.), U.S. Engr. Dept. (Res., 1757 Bidwell Way), Sacramento, Calif.

SILLA, MARIO ROCCO (Jun. '43), Engr., Trainee, Dravo Corp., Neville Island, Pittsburgh (Res., 225 Broad St., Sewickley), Pa.

SNELL, RICHARD DIMMICK (Jun. '43), Field Eng. Supervisor, Fairchild Aviation Corp., 475 Tenth Ave., New York (Res., 36 Slater Ave., Tuckahoe 7), N.Y.

SORENSEN, HAROLD WINTHER (Jun. '43), Draftsman, Atkinson-Pollock Constr. Co., Box 259 (Res., 435 Almond Ave.), Long Beach 4, Calif.

SOWERS, GEORGE FREDERICK (Jun. '43), Junior Hydr. Engr., TVA, 700 Union Bldg., Knoxville, Tenn.

STANLEY, LEWIS ADAMS (M. '43), Engr., U.S. Army Engrs., 502 Pittock Block, Portland, Ore.

STEFFENSEN, ROBERT WILLIAM (Jun. '43), Junior Engr., U.S. Engr. Office, 700 Union Gardian Bldg., Detroit, Mich.

STEPHENOFF, MACKE STEPHENS, JR. (Jun. '43), Weight Analyst, Goodyear Aircraft Corp. (Res., Y.M.C.A.), Arkon, Ohio.

STONE, SANFORD HERBERT (Jun. '43), Ensign, U.S.N.R., 327 Michigan Union, Ann Arbor, Mich.

STUENKEL, PAUL LLOYD (Assoc. M. '43), Senior Engr., Bridge Design, State Highway Comm. (Res., 1614 Medford), Topeka, Kans.

SYMES, LESTER HOWARD (Jun. '43), Structural Engr., Chance Vought Aircraft, Stratford (Res., 2898 North Main St., Apt. D-9, Bridgeport), Conn.

THAYER, ROBERT ELMORE (Jun. '43), Junior Engr., Boeing Aircraft Co. (Res., 1743 Boylston), Seattle 22, Wash.

THOMPSON, WILLIAM ERWIN, JR. (Assoc. M. '43), Associate Engr., U.S. Engrs., Army Air Base, Rapid City, S.Dak.

TURNER, WILLIAM LAWRENCE (Assoc. M. '43), Asst. Engr., Belmont County Eng. Dept., Court House (Res., 111 Park Drive), St. Clairsville, Ohio.

WAGNER, CARL, JR. (Jun. '43), Ensign, U.S.N., 733 West College Ave., State College 5, Pa.

WALLEN, AVERY COLUMBUS (Jun. '43), Chf. Field Draftsman, Chas. T. Main, Inc., Holston Ordnance Works, Kingsport, Tenn.

WEEKS, LAWRENCE MICHAEL (Jun. '43), Junior Engr., McDonnell Aircraft Corp., Sarah and Laclede (Res., 5843 Bartmer), St. Louis, Mo.

WEHMEYER, JOE LAMAR (M. '43), Engr. of Safety and Traffic, Board of Wayne County Road Commrs., 3800 Barlum Tower, Detroit 26, Mich.

WELDAY, CHAPLINE FOCH (Jun. '43), Ensign, CEC, U.S.N.R., E 1—83, Camp Peary, Va.

WESCOTT, LOUIS SEBASTIAN (Assoc. M. '43), Chf. Engr., Constr., Harrison Constr. Co., 1101 Western Ave. (Res., 113 Marlin Drive, West), Pittsburgh (16), Pa.

WHEELER, HENRY RUSSELL, JR. (Jun. '43), 2d Lt., U.S. Army, 8 Forest St., Baldwinville, Mass.

WHITE, WARREN MALELEEL (Assoc. M. '43), Cons. Engr., Turner & White, Union National Bank (Res., 3736 Darcus), Houston, Tex.

WICHMAN, JAMES ROBERT (Jun. '43), Junior Engr., U.S. Navy Dept., Bureau of Ships, 17th and Constitution Ave., Washington, D.C. (Res., 3205 Twenty-third St., North, Arlington, Va.)

WISCHMEYER, WILLIAM JORGENSEN (Jun. '43), Junior Chemist, Water Works, U.S. Army Engrs., Care, Post Engr., Camp Breckenridge, Ky.

WRIGHT, CHARLES VICTOR (Jun. '43), With U.S. Army, 116 Denver St., Springfield, Mass.

WRIGHT, ROBERT DAVIS (Assoc. M. '43), Acting Supt., City Water Dept., Lynchburg, Va.

ZAGARELLA, ANTHONY (Jun. '43), Lt., U.S. Army, Battery D, 142d Antiaircraft, Artillery Battalion, Camp Edwards, Mass.

MEMBERSHIP TRANSFERS

ADAMS, ROB ROY (Assoc. M. '38; M. '43) (J. E. Sirrine & Co.), 215 South Main St. (Res., 713 Crescent Ave.), Greenville, S.C.

ATKIN, MORRIS (Jun. '33; Assoc. M. '43), Structural Designer, Anaconda Copper Mining Co., 25 Broadway (Res., 440 West 24th St.), New York 11, N.Y.

COMERFORD, WILLIAM PIERRE (Jun. '33; Assoc. M. '43), Engr., Corry & Zurmuhlen, 14 East 47th St., New York (Res., 56-36 Two hundred and thirteenth St., Bayside), N.Y.

COOLIDGE, WARREN ALGERNON (Assoc. M. '29; M. '43), Prof., Civ. Eng., Vanderbilt Univ., College Hall, Vanderbilt Univ., Nashville, Tenn.

CORUM, WILLIAM THOMAS (Jun. '36; Assoc. M. '43), Engr., Aircraft Eng. Dept., Rheem Mfg. Co., 4361 Firestone Blvd., South Gate (Res., 220 West 118th Pl., Los Angeles 3), Calif.

FOWLER, HOMER EDISON (Jun. '24; Assoc. M. '26; M. '43), Dist. Maintenance Engr., U.S. Public Roads Administration, 1109 Main Post Office Bldg., St. Paul, Minn.

GLACE, IVAN MAXWELL, JR. (Jun. '41; Assoc. M. '43), Ensign, CEC, U.S.N.R., 22 South 22d St., Harrisburg, Pa.

HALL, LEWIS WATSON (Assoc. M. '30; M. '43), Road and Railroad Engr., Sanderson & Porter, Pine Bluff Arsenal, Pine Bluff (Res., 5601 Country Club Blvd., Little Rock), Ark.

HASELTON, GAGE (Jun. '04; Assoc. M. '13; M. '43), Div. Engr., S. P. Co., 361 Union Station (Res., 1107 South West 20th Ave.), Portland, Ore.

HOWE, JOSEPH WARNER (Assoc. M. '33; M. '43), Prof. and Head, Dept. of Mechanics and Hydraulics, State Univ. of Iowa, Eng. Bldg., Iowa City, Iowa.

KAMINER, JAMES HEATH (Jun. '38; Assoc. M. '43), Capt., Corps of Engrs., U.S. Army, Lexington, S.C.

KNOX, JOHN JAMES (Jun. '29; Assoc. M. '35; M. '43), Asst. Engr., Interborough Rapid Transit Div., New York City Transit System, 2545 Seventh Ave., New York (Res., 33—18 Two hundred and twelfth St., Bayside), N.Y.

PODAS, CHARLES ROBERT (Jun. '39; Assoc. M. '43), Asst. Engr., Ralph D. Thomas & Associates, 1200 Second Ave., South (Res., 5344 Thirty-seventh Ave., South), Minneapolis, Minn.

REUTTER, JOHN G. (Jun. '39; Assoc. M. '43), Chf. Engr., Hungerford & Terry, Inc., Atlantic Div. (Res., 616 North Delsea Drive), Clayton, N.J.

RICHHEIMER, CHARLES EDWARD (Assoc. M. '38; M. '43), (Reynolds, Smith & Hills), Box 4817, Jacksonville, Fla.,

ROHWER, CARL (Assoc. M. '23; M. '43), Irrig. Engr., Div. of Irrig. SCS, U.S. Dept. of Agriculture, Colorado Experiment Station, Fort Collins, Colo.

SCHWALEN, HAROLD CHRISTY (Assoc. M. '29; M. '43), Prof. Agri. Eng., Univ. of Arizona, Tucson, Ariz.

SEYMOUR, HAROLD JAMES (Assoc. M. '42; M. '43), Asst. City Engr., City Hall, Elizabeth, N.J.

STEEG, HENRY BELL (Assoc. M. '28; M. '43), (Henry B. Steeg & Associates), Pres., Eng.-Constr. Corp., 129 East Market Bldg., Indianapolis, Ind.

VAN CAMP, PAUL MILTON (Assoc. M. '31; M. '43), Cons. Engr., Patch Bldg., Southern Pines, N.C.

WEISS, FREDERICK LOUIS (Jun. '36; Assoc. M. '43), Engr. (Civ.), U.S. Engr. Dept., 1209 Eighth St. (Res., 2617 Seventeenth St.), Sacramento 14, Calif.

WILLIE, LAVERN JAY (Jun. '34; Assoc. M. '43), Office Engr., United Eng. & Foundry Co., Box 2158 (Res., N 2120 Argonne Rd.), Spokane, Wash.

REINSTATEMENTS

ABBOTT, ELI, JR., M., reinstated Aug. 24, 1943.

CAMILLI, DAVID JOHN, Assoc. M., reinstated Sept. 9, 1943.

CRITES, EVERETT CLAY, Assoc. M., reinstated Sept. 8, 1943.

IRVING, THOMAS HENRY, M., reinstated Sept. 1, 1943.

KIKER, JOHN EWING, JR., M., reinstated Jan. 1, 1943.

RESIGNATIONS

BERMAN, MORRIS, Assoc. M., resigned Jan. 1, 1943.

DOWNING, CLAIRE ANSEL, M., resigned Aug. 10, 1943.

FURLONG, WRAY CLIFFORD, Jun., resigned Aug. 23, 1943.

MCKEE, JACK EDWARD, Jun., resigned Aug. 6, 1943.

NEIBERT, JAMES SHIVELY, Assoc. M., resigned July 1, 1943.

OSBORN, JOHN EDWARD, Jun., resigned Aug. 27, 1943.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

OCTOBER 1, 1943 NUMBER 10

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North American until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for subprofessional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i.e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

BAASTAD, MAX FRITHJOF HJORTH (BOSTAD, FRED) San Francisco, Calif. (Age 40) (Claims RCA 4.8 RCM 7.0) Sept. 1940 to date Engr.-in-Chg., H. J. Brunnier; previously Engr.-in-Chg., Glendale (Calif.) Public Service Dept.; Structural Engr., Gunsealed Bldgs., San Diego.

BECKLER, BENJAMIN FRANKLIN, JR., Kingman, Ariz. (Age 35) (Claims RCA 2.0 RCM 5.1) April 1942 to date Capt., U.S. Army; previously Mun. and Testing Engr., Robert & Co., Atlanta, Ga.; County Engr., Athens County, Ohio.

BELLOWS, WARREN SYLVANUS (Assoc. M.), Houston, Tex. (Age 54) (Claims RCA 6.0 RCM 15.0) 1919 to date in private practice as W. S. Bellows Constr. Co., at present Pres. of company.

CHANDLER, SYDNEY WILLIAM, Baltimore, Md. (Age 45) (Claims RCA 5.2 RCM 9.6) Sept. 1928 to date with U.S. Engr. Office in various capacities, since Aug. 1941 as Senior Engr., Area Engr. and Prin. Civilian Asst. to Area Engr. (commissioned officer), Aberdeen Proving Ground, Md.

DAVIDSON, OLE, Knoxville, Tenn. (Age 66) (Claims RCA 10.4 RCM 16.7) Aug. 1910 to July 1933 and Sept. 1940 to date with Stone & Webster Eng. Corporation in various capacities, at present as Div. Supt.; in the interim Supt., CCC Camp: farming.

DILLARD, FRANK CARLTON, Nelscott, Ore. (Age 62) (Claims RCA 5.1 RCM 31.0) Sept. 1930 to date on consulting engineering, contracting, and financing.

EVANS, HOWARD TASKER, San Mateo, Calif. (Age 49) (Claims RCA 6.0 RCM 8.3) June 1941 to date Lieut. Comdr., CEC, USNR; previously Structural Designer and Engr., Stone & Webster Eng. Corporation, Boston, Mass.

FELLOWS, FRED GEORGE, Ponca City, Okla. (Age 57) (Claims RCA 9.3 RCM 17.6) March 1942 to date Instructor, Univ. of Oklahoma; previously with Marland Refining Co. (now Continental Oil Co.) in various capacities, finally as Refinery Supt.

GRISWOLD, HAROLD WILEY (Assoc. M.), Hartford, Conn. (Age 56) (Claims RC 18.0 D 10.5) 1930 to date Deputy Mgr. and Deputy Chf. Engr., Water Bureau, Metropolitan Dist., Hartford County, Conn.

HUNTER, HOMER ALEXANDER (Assoc. M.), Dallas, Tex. (Age 39) (Claims RCA 6.6 RCM 9.3) July 1941 to date Supt., Dallas (Tex.) Water Dept.; previously Asst. Director of Public Works, City of Dallas, Tex.; Secy. and Executive Director, Housing Authority, Ft. Worth.

KLAUS, FRED JAMES, Sacramento, Calif. (Age 61) (Claims RCA 12.9 RCM 18.5) 1929 to date City Engr., and (part of time) Acting City Mgr., Sacramento.

LE VAN, JAMES HENRY (Assoc. M.), Atlanta, Ga. (Age 38) (Claims RCA 6.6 RCM 6.7) June 1931 to date with U.S. Public Health Service in various capacities, at present as Water Security Officer.

MARSHALL, JAMES DAVIES (Assoc. M.), Kansas City, Mo. (Age 39) (Claims RCA 4.0 RCM 12.5) June 1938 to date Partner, Marshall & Brown, Archts. & Engrs.; previously Cons. Engr., Kansas City.

MILLER, ALFRED LAWRENCE (Assoc. M.), Seattle, Wash. (Age 46) (Claims RCA 5.7 RCM 14.1) Oct. 1923 to date with Dept. of Civ. Eng., Univ. of Wash., Seattle, at present as Prof.

NEWMAN, JOSEPH PATRICK, New York City. (Age 42) (Claims RCA 5.5 RCM 12.4) Aug. 1940 to date Constr. Supt., Metropolitan Device Corporation, Power Plant Design Div., Brooklyn, N.Y.; previously Constr. Engr., Associated Contractors; Associate Engr., FWA, PWA, New York City.

PRINGLE, THOMAS BARBOUR, Falls Church, Va. (Age 40) (Claims RCA 6.1 RCM 7.4) April 1942 to date with War Dept., as Engr., and (since Aug. 1942) Senior Engr.; previously Layout Engr. and Asst. Cost Engr. on construction of synthetic rubber plant; with State Road Comm. of West Virginia in various capacities.

REYNOLDS, FRANK HOWARD, Sacramento, Calif. (Age 60) (Claims RCA 19.0 RCM 16.0) 1910 to date Cons. Civ. Engr. with various cities, irrigation projects and structural contractors, at present as Cons. Engr., Roseville, Calif.

STEGMAN, WALTER WILLIAM, Wheeling, W.Va. (Age 50) (Claims RCA 4.2 RCM 24.5) July 1927 to date in private practice of civil and mining engineering, Wheeling.

SUPPIGER, EDWARD WASHINGTON (Assoc. M.), Dayton, Ohio. (Age 36) (Claims RCM 6.3) June 1942 to date Chf. Rotors Unit, Propeller Laboratory, Eng. Div., Wright Field; Capt., Army Air Forces; previously teaching at Coll. of Eng., Univ. of Illinois, finally as Associate.

VOLLMER, ALEXANDER RUSSELL (Assoc. M.), Baltimore, Md. (Age 37) (Claims RCA 5.2 RCM 7.1) April 1929 to Sept. 1932 and Oct. 1933 to date with Whitman, Requardt & Smith in various capacities, at present as Prin. Asst. Project Engr.

WALMSLEY, JAMES LOUIS, Bethlehem, Pa. (Age 39) (Claims RCA 4.4 RCM 11.7) June 1926 to date with McClintic Marshall Co. (Bethlehem Steel Co.) in various capacities, since July 1943 as Designing Engr.

WARNER, FRANCIS REYBOLD, Drexel Hill, Pa. (Age 41) (Claims RCM 9.0) Aug. 1936 to date Supt., American Dredging Co., Philadelphia, Pa., in charge of dredging on canal, airport, etc.

YOUNG, BERT JAMES, New Rochelle, N.Y. (Age 57) claims (RCA 12.8 RCM 17.0) at present with Jenks & Ballou, Engrs., Providence, R.I.; previously on work for U.S. Naval Operating Base; Structural Engr., Burns & Rowe, New York City; Chf. Elec. Engr., Madigan-Hyland, New York City.

APPLYING FOR ASSOCIATE MEMBER

BAHN, ADOLPH, JR., Yonkers, N.Y. (Age 34) (Claims RCA 9.5) 1942 to date Field Engr., Gibbs & Hill, New York City; previously Engr., Consolidated Edison Co., Inc., New York City.

BENSCHRIDT, ADOLPH F. (Junior), New York City. (Age 33) (Claims RCA 3.2 RCM 1.2) April 1937 to date with CEC, U.S. Navy, at present as Lt. Comdr.

BROWN, FRANK EUGENE, Diablo Heights, C.Z. (Age 34) (Claims RCA 7.8 RCM 1.7) Feb. 1940 to date with The Panama Canal, Balboa, C.Z., as Asst. Engr. and (since Feb. 1942) Associate Materials Engr.; previously with City of Hammond, Ind., in various capacities.

BUZO, ZIHNI JUSUP (Junior), Cremorne, Sydney, Australia. (Age 29) (Claims RCA 4.8) March 1940 to date Designing Engr., Gutteridge, Haskins & Davey, Sydney; previously Structural Draftsman, Huril & Douglas, Ltd., Structural Engrs., Sydney; San. Engr., Dept. of Public Health, Tirana, Albania.

COWAN, WOODY LEON, Lincoln, Nebr. (Age 40) (Claims RCA 7.7 RCM 0.6) April 1935 to date with SCS in various capacities, since July 1942 as Zone Technician.

DARDEN, WILLIAM ALLEN, JR. (Junior), Dayton, Ohio. (Age 33) (Claims RCA 2.9 RCM 5.0) May 1942 to date with Corps of Engrs., U.S. Army, at present as Capt.; previously with U.S. Engrs., Nashville, Tenn., in various capacities.

DEGRAFF, ALBERT GEORGE, Philadelphia, Pa. (Age 44) (Claims RCA 6.0 RCM 6.9) 1930 to 1931 and 1935 to date Engr., The Austin Co.

FISHER, JOHN DONALDSON FORD, Lorain, Ohio. (Age 43) (Claims RCA 12.5 RCM 8.2) 1940 to date Acting Mgr., Maintenance Parts Div., Thew Shovel Co.; previously Highway Design Engr. (bituminous construction), Foote Co., Nunda, N.Y.

GILCHRIST, JAMES JOSEPH, Camp Maxey, Tex. (Age 29) (Claims RCA 8.1) Aug. 1941 to date with Corps of Engrs., U.S. Army, as Post Engr.; previously in business as Gilchrist Brothers, Gen. Contrs., Las Cruces, N.Mex., being Mgr. and Constr. Engr.

GILLETTE, EDWARD SCRANTON, Chicago, Ill. (Age 45) (Claims RCA 15.0) 1922 to date with Gillette Publishing Co., since 1928 as Gen. Mgr., Vice-Pres., and Publisher.

GREEN, CHESTER HENRY, La Canada, Calif. (Age 38) (Claims RCA 6.8) 1940 to date Storm Drain Designer, Los Angeles County Engr.'s Office; previously in Los Angeles County Surveyor's Office, Street Opening and Widening Sec., as Asst. to Engr.

GROHMAN, GEORGE JAMES, Sacramento, Calif. (Age 42) (Claims RCA 12.4) May 1931 to date with California Div. of Highways, Sacramento, in various capacities, since May 1937 as Computer, Writer and Compiler.

HARRISON, WILLIAM EDWARD, New York City. (Age 34) (Claims RCA 1.5) May 1942 to date with Co. A, 343d Engrs., U.S. Army, as 1st Lt., and (since Jan. 1943) Capt.; previously with Hamilton County Engrs. Office, Cincinnati, Ohio, as Asst. Engr., and Bridge Engr.

HILLYARD, HARVEY WOOD, Houma, La. (Age 33) (Claims RCA 7.3 RCM 2.7) Jan. 1941 to date on active duty with USNR, first as Lt. (jg) and Lt., and since Aug. 1942 Officer-in-Charge and (at present) Lt. Comdr., CEC; previously with Bureau of Reclamation, in various capacities.

HOLLAND, GEORGE PERCIVAL, Knoxville, Tenn. (Age 47) (Claims RCA 23.5) Nov. 1941 to date Associate Civ. Engr., Highway & R.R. Div., TVA; previously Res. Engr. and Senior Res. Engr., Tennessee Dept. of Highways and Public Works, Nashville.

HUTCHENS, HAROLD RAYMOND (Junior), Kansas